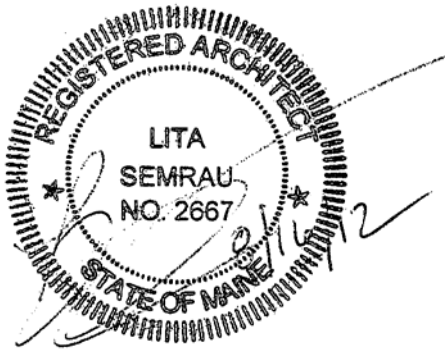
UNIVERSITY OF NEW ENGLAND

PATIENT CARE CENTER

Construction Documents

August 16, 2012

Project # 12502



PORT ▪ CITY
ARCHITECTURE

University Of New England

Patient Care Center
Construction Documents

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University of New England
SUPPLEMENTAL CONDITIONS
10-07-05

THE FOLLOWING RULES AND REGULATIONS OF THE UNIVERSITY OF NEW ENGLAND SHALL BE OBSERVED BY EVERY CONTRACTOR, SUBCONTRACTOR, THEIR AGENTS, SERVANTS AND EMPLOYEES:

1. CONDUCT: The contractor shall not interfere with the daily operation of the students, faculty, or business of the University. The contractor shall be responsible for the conduct of all employees, subcontractors, business invitees or other persons related to, working on, or involved in the contractors performance of the "work" on the "project". No radios are permitted on the project site without prior approval from the Owner. All workers and visitors will be restricted to the area immediately surrounding the "project" site, and will not be permitted access to the University's community facilities. Smoking is not permitted within 50 feet of any building. Contractors working on site are to be fully clothed (pants, shirts, and shoes) at all times.

2. PARKING: The University has in force, an established set of rules and regulations regarding vehicle parking, traffic regulations and towing. It will be the responsibility of the contractor to ensure that all persons, under his control, working on the "project" comply with these rules and regulations. Contractor parking on campus is limited to the construction site, or other pre-determined areas.

3. WORK HOURS: Work on the "project" will not commence prior to 7:00AM on weekdays, and will cease at 5:00PM. No work will be permitted outside these hours without the permission of the Department of Campus Services, 207-602-2262. Work in or around the residence halls must be delayed until after 9am. Week-end work is not permitted on the University's campus unless prior approval is obtained from the Department of Campus Services. In such event, all personnel will be required to report to the Security Office upon arrival and when departing the campus for the day.

4. THE UNIVERSITY FACILITIES: The contractor is required to obtain written approval from the Department of Campus Services prior to the contractors intentional causing the interruption of any of the University's fire or safety equipment or utilities, or interferes with it's normal daily operations. Appropriate, code compliant, LOCK OUT- TAG OUT procedures will be utilized by the contractor.

5. HAZARDOUS MATERIALS, HAZARDOUS WASTE & PETROLEUM PRODUCTS: THE UNIVERSITY PROHIBITS THE DISPOSAL OF ANY ENVIRONMENTALLY UNSAFE MATERIALS OR WASTE ON ITS CAMPUS, AND IN PARTICULAR THROUGH ITS DRAINAGE SYSTEMS. Any spills or accidental discharges of hazardous materials are to be immediately reported to the University's Environmental Health and Safety Coordinator, 207-602-2488. If it becomes necessary for the contractor to dispose of any chemicals, paint, or other waste materials, the University, through its Environmental Health and Safety Coordinator, will assist in arranging for such disposal, but the contractor is responsible for all expenses associated with disposal of

contractor generated wastes. The contractor is responsible for coordinating the flushing or disinfection of any utility lines with the Facilities Management Department **and** the Waste Water Treatment Plant Operator prior to initiating these activities. The contractor must also place into secondary containment all petroleum products and submit an inventory of those products to the Environmental Health and Safety Coordinator.

6. MATERIAL SAFETY DATA SHEETS: The University maintains a complete set of MSDS for any potential chemical hazards. All contractors shall have on hand MSDS for all hazardous materials used on the "project". All contractors shall comply with the appropriate laws, rules and regulations of the US Environmental Protection Agency, Occupational Safety and Health Administration, and the State of Maine, Department of Environmental Protection.

7. PERSONAL INJURY: The contractor shall report to the Department of Campus Services all personal injuries, which require medical attention, within eight (8) hours after the occurrence of such personal injury.

8. SIGNS AND BARRIERS: The contractor shall be responsible for posting all signs and erecting all barriers at the work site to prevent all unauthorized personnel from entering the work area. The contractor is responsible for ensuring the safety of all of their employees, sub-contractors and guests to the construction site.

9. ALCOHOL AND DRUGS: The consumption of any alcoholic beverage, or the use of any non -prescription drug or controlled substance is not permitted on the work site, on the campus of the University, or in any area of the University under the control and supervision of the contractor. Alcohol or drug possession on the campus, or work site, will result in the immediate removal of the individual involved, and the contractor.

10. SALES TAX: The University is tax exempt, thus does not pay sales tax for labor or materials provided to the University. The University's tax-exempt number is E101-29.

11. ADA: All work performed by the contractor shall be in compliance with the provisions of the *AMERICANS WITH DISABILITIES ACT OF 1990* (Public Law 101.336) 42 USC 12101 and the *REHABILITATION ACT OF 1973*, 34 CFR part 104, 29 USC 794

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Work covered by the Contract Documents.
2. Type of the Contract.
3. Work phases.
4. Work under other contracts.
5. Products ordered in advance.
6. Use of premises.
7. Owner's occupancy requirements.
8. Work restrictions.
9. Specification formats and conventions.

B. Related Sections include the following:
1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: UNE Patient Care Center

1. Project Location: 716 Stevens Avenue, Portland, Maine

B. Owner: University of New England

1. Owner's Representative: Alan Thibeault - Associate Director of Campus
716 Stevens Avenue, Portland, ME 04103

C. Architect: Lita Semrau - Vice President
65 Newbury Street, Portland, ME 04101

D. Contractor: Matt Cook - Engaged as Contractor for this Project
Allied/Cook Construction
P.O. Box 1369, Portland, ME 04101

E. The Work consists of the following:

The Work consists of a new 2 story building ~36,000 sf. The building will include dental, dental hygiene and Inter Professional Education clinics, a dental simulation lab and support spaces which includes, but are not limited too, teaching labs, offices, working labs and waiting areas. The exterior of the new building will include brick, precast concrete, copper cladding, glass curtain wall, fiberglass windows, aluminum doors, steel doors and a paneling system. (See drawings for details). Interior finishes include gypsum wall board, millwork, pre-fabricated millwork including lockers, paver tiles, resilient flooring, carpet and acoustical ceiling tiles. The building will have two elevators. Project includes all associated mechanical, electrical, plumbing, civil and structural.

1.4 TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

1.5 USE OF PREMISES

A. General: Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits.

C. Use of Site: Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated without permission of the owner.

1. Limits: Confine constructions operations to area indicated on Drawings.

    a. Limit site disturbance, including earthwork and clearing of vegetation, to 40 feet (12.2 m) beyond building perimeter; 5 feet (1.5 m) beyond primary roadway curbs, walkways, and main utility branch trenches; and 25 feet (7.6 m) beyond pervious paving areas.

    b. At property line bordering the cemeteries, do not disturb earth within 25'-0' of property line.

2. Owner Occupancy: Allow for Owner occupancy of Project site.
3. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

    a. Schedule deliveries to minimize use of driveways and entrances.
    b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.6 OWNER'S OCCUPANCY REQUIREMENTS

A. Full Owner Occupancy: Owner will occupy existing and adjacent building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits, unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

B. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of building.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.7 WORK RESTRICTIONS

A. **WORK HOURS:** Work on the "project" will not commence prior to 7:00AM on weekdays, and will cease at 5:00PM. No work will be permitted outside these hours without the permission of the Department of Campus Services, 207-602-2262. Work in or around the residence halls must be delayed until after 9am. Week-end work is not permitted on the University’s campus unless prior approval is obtained from the Department of Campus Services. In such event, all personnel will be required to report to the Security Office upon arrival and when departing the campus for the day.

1.8 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format and CSI/CSC's "MasterFormat" numbering system.

1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.

2. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

1.9 MISCELLANEOUS PROVISIONS

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Provide IPE fitout as indicated by drawings A1.11A

END OF SECTION 012300

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections include the following:
   1. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
   2. Division 01 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

   1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:

      a. Application for Payment forms with Continuation Sheets.
      b. Submittals Schedule.
      c. Contractor's Construction Schedule.

   2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
   3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:

    a. Project name and location.
    b. Name of Architect.
    c. Architect's project number.
    d. Contractor's name and address.
    e. Date of submittal.

2. Submit draft of AIA Document G703 Continuation Sheets.
3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

    a. Related Specification Section or Division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value.

        1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

    a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.

7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
9. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

10. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: Progress payments shall be submitted to Architect by the 15th of the month. The period covered by each Application for Payment is one month, ending on the date indicated on the contract and monthly thereafter.

D. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.

E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Construction Manager by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of Values.
3. Contractor's Construction Schedule (preliminary if not final).
4. Products list.
5. Schedule of unit prices.
6. Submittals Schedule (preliminary if not final).
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of building permits.
10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
11. Initial progress report.
12. Report of preconstruction conference.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.
15. Data needed to acquire Owner's insurance.
16. Initial settlement survey and damage report if required.

I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Coordination Drawings.
2. Administrative and supervisory personnel.
3. Project meetings.
4. Requests for Interpretation (RFIs).

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

C. Related Sections include the following:
1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.4 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.
9. Project closeout activities.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone

numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1. Include special personnel required for coordination of operations with other contractors.

1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Tentative construction schedule.
    b. Phasing.
    c. Critical work sequencing and long-lead items.
    d. Designation of key personnel and their duties.
    e. Procedures for processing field decisions and Change Orders.
    f. Procedures for RFIs.
    g. Procedures for testing and inspecting.
    h. Procedures for processing Applications for Payment.
    i. Distribution of the Contract Documents.
    j. Submittal procedures.

k. Preparation of Record Documents.
l. Use of the premises.
m. Work restrictions.
n. Owner's occupancy requirements.
o. Responsibility for temporary facilities and controls.
p. Construction waste management and recycling.
q. Parking availability.
r. Office, work, and storage areas.
s. Equipment deliveries and priorities.
t. First aid.
u. Security.
v. Progress cleaning.
w. Working hours.

3. Minutes: Record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. The Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility problems.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written recommendations.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: In addition to representatives of Owner, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

        1) Review schedule for next period.

    b. Review present and future needs of each entity present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Status of submittals.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site utilization.
        8) Temporary facilities and controls.
        9) Work hours.
        10) Hazards and risks.
        11) Progress cleaning.
        12) Quality and work standards.
        13) Status of correction of deficient items.
        14) Field observations.
        15) RFIs.
        16) Status of proposal requests.
        17) Pending changes.
        18) Status of Change Orders.
        19) Pending claims and disputes.
        20) Documentation of information for payment requests.

3. Minutes: Record the meeting minutes.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

    a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

E. Coordination Meetings: Conduct Project coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Combined Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    b. Schedule Updating: Revise Combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    c. Review present and future needs of each contractor present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Status of submittals.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site utilization.
        8) Temporary facilities and controls.
        9) Work hours.
        10) Hazards and risks.
        11) Progress cleaning.
        12) Quality and work standards.
        13) Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.8 REQUESTS FOR INTERPRETATION (RFIs)

A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.

1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:

1. Project name.
2. Date.
3. Name of Contractor.
4. Name of Architect.
5. RFI number, numbered sequentially.
6. Specification Section number and title and related paragraphs, as appropriate.
7. Drawing number and detail references, as appropriate.
8. Field dimensions and conditions, as appropriate.
9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
10. Contractor's signature.
11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

    a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

C. Hard-Copy RFIs: CSI Form 13.2A.

1. Identify each page of attachments with the RFI number and sequential page number.

D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

E. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for coordination information already indicated in the Contract Documents.

d. Requests for adjustments in the Contract Time or the Contract Sum.
e. Requests for interpretation of Architect's actions on submittals.
f. Incomplete RFIs or RFIs with numerous errors.

2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Daily construction reports.
5. Field condition reports.
6. Special reports.

B. Related Sections include the following:
1. Division 01 Section "Payment Procedures" for submitting the Schedule of Values.
2. Division 01 Section "Submittal Procedures" for submitting schedules and reports.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the Schedule of Values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Architect.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

H. Major Area: A story of construction, a separate building, or a similar significant construction element.

I. Milestone: A key or critical point in time for reference or measurement.

J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

K. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 SUBMITTALS

A. Qualification Data: For scheduling consultant.

B. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Architect's final release or approval.

C. Preliminary Construction Schedule: Submit three opaque copies.

1. Approval of cost-loaded preliminary construction schedule will not constitute approval of Schedule of Values for cost-loaded activities.

D. Contractor's Construction Schedule: Submit three opaque copies of initial schedule, large enough to show entire schedule for entire construction period.

E. CPM Reports: Concurrent with CPM schedule, submit three copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.
4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

F. Daily Construction Reports: Keep on site for review from client, contractor or other design staff if requested.

G. Material Location Reports: Submit two copies at monthly intervals.

H. Field Condition Reports: Keep on site for review from client, contractor or other design staff if requested.

I. Special Reports: Submit two copies at time of unusual event.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including phasing, work stages, area separations, interim milestones and partial Owner occupancy.
4. Review delivery dates for Owner-furnished products.
5. Review time required for review of submittals and resubmittals.
6. Review requirements for tests and inspections by independent testing and inspecting agencies.
7. Review time required for completion and startup procedures.
8. Review and finalize list of construction activities to be included in schedule.
9. Review submittal requirements and procedures.
10. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
2. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

a. At Contractor's option, show submittals on the Preliminary Construction Schedule, instead of tabulating them separately.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. Time Frame: Extend schedule from date established for current date to date of Final Completion. Please include any items that might effect construction timeline.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
4. Startup and Testing Time: Include not less than required days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Work Restrictions: Show the effect of the following items on the schedule:
    a. Coordination with existing construction.
    b. Limitations of continued occupancies.
    c. Uninterruptible services.
    d. Partial occupancy before Substantial Completion.
    e. Use of premises restrictions.
    f. Provisions for future construction.
    g. Seasonal variations.
    h. Environmental control.
6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
    a. Subcontract awards.
    b. Submittals.
    c. Purchases.
    d. Mockups.
    e. Fabrication.
    f. Sample testing.

g. Deliveries.
h. Installation.
i. Tests and inspections.
j. Adjusting.
k. Curing.
l. Startup and placement into final use and operation.

7. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

a. Structural completion.
b. Permanent space enclosure.
c. Completion of mechanical installation.
d. Completion of electrical installation.
e. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

F. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.

1. Refer to Division 01 Section "Payment Procedures" for cost reporting and payment procedures.
2. Contractor shall assign cost to construction activities on the CPM schedule. Costs shall not be assigned to submittal activities unless specified otherwise but may, with Architect's approval, be assigned to fabrication and delivery activities. Costs shall be under required principal subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
3. Each activity cost shall reflect an accurate value subject to approval by Architect.
4. Total cost assigned to activities shall equal the total Contract Sum.

G. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Preliminary Network Diagram: Submit diagram within 14 days of date established for commencement of the Work. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for commencement of the Work.

    a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication.
    f. Utility interruptions.
    g. Installation.
    h. Work by Owner that may affect or be affected by Contractor's activities.
    i. Testing and commissioning.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

E. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Principal events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the Schedule of Values).

F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

G. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.

    a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
    b. Submit value summary printouts one week before each regularly scheduled progress meeting.

2.4 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.

4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (refer to special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial Completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Sections include the following:

1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
3. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
4. Division 01 Section "Closeout Procedures" for submitting warranties.
5. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
6. Divisions 02 through 49 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Architect's responsive action.

B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.

E. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately **6 by 4 inches** on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information on label for processing and recording action taken:

    a. Project name.
    b. Date.
    c. Name and address of Architect.
    d. Name and address of Contractor.
    e. Name and address of subcontractor.
    f. Name and address of supplier.
    g. Name of manufacturer.
    h. Submittal number or other unique identifier, including revision identifier.

        1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).

    i. Number and title of appropriate Specification Section.
    j. Drawing number and detail references, as appropriate.
    k. Location(s) where product is to be installed, as appropriate.
    l. Other necessary identification.

F. Deviations: Highlight, encircle or otherwise specifically identify deviations from the Contract Documents on submittals.

G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review received from sources other than Contractor.

1. Transmittal Form: Use AIA Document G810.
2. Transmittal Form: Provide locations on form for the following information:

a. Project name.
b. Date.
c. Destination (To:).
d. Source (From:).
e. Names of subcontractor, manufacturer, and supplier.
f. Category and type of submittal.
g. Submittal purpose and description.
h. Specification Section number and title.
i. Drawing number and detail references, as appropriate.
j. Transmittal number.
k. Submittal and transmittal distribution record.
l. Remarks.
m. Signature of transmitter.

3. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.

I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked "Reviewed" or "Approved as noted."

J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

K. Use for Construction: Use only final submittals with mark indicating "Reviewed" or "Approved as noted" taken by Architect.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

1. Submit electronic submittals directly to extranet specifically established for Project.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's written recommendations.
b. Manufacturer's product specifications.
c. Manufacturer's installation instructions.
d. Standard color charts.
e. Manufacturer's catalog cuts.
f. Wiring diagrams showing factory-installed wiring.
g. Printed performance curves.
h. Operational range diagrams.
i. Mill reports.
j. Standard product operation and maintenance manuals.
k. Compliance with specified referenced standards.
l. Testing by recognized testing agency.
m. Application of testing agency labels and seals.
n. Notation of coordination requirements.

4. Submit Product Data before or concurrent with Samples.
5. Number of Copies: Submit five copies of Product Data, unless otherwise indicated. Architect will return four copies. Mark up and retain one returned copy as a Project Record Document.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Dimensions.
b. Identification of products.
c. Fabrication and installation drawings.
d. Roughing-in and setting diagrams.
e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
f. Shopwork manufacturing instructions.

g. Templates and patterns.
h. Schedules.
i. Design calculations.
j. Compliance with specified standards.
k. Notation of coordination requirements.
l. Notation of dimensions established by field measurement.
m. Relationship to adjoining construction clearly indicated.
n. Seal and signature of professional engineer if specified.
o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 40 inches (750 by 1000 mm).
3. Number of Copies: Submit two opaque (bond) copies of each submittal. Architect will send an electronic submittal back to the contractor and will post all submittals online on Port City Architecture's website. **NO HARD COPIES WILL BE RETURNED TO THE CONTRACTOR.**

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.
d. Number and title of appropriate Specification Section.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit one set of Samples. Architect will retain Sample sets.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product.
2. Number and name of room or space.
3. Location within room or space.
4. Number of Copies: Submit four copies of product schedule or list, unless otherwise indicated. Architect will return two copies.

    a. Mark up and retain one returned copy as a Project Record Document.

F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation" for Construction Manager's action.

G. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

H. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."

I. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

J. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Architect will return one copy.

    a. Mark up and retain one returned copy as a Project Record Document.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.

1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies but will post the information on Port City Architecture's website.
2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."

B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

M. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."

N. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

O. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

R. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

S. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a

product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

T. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

U. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

V. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.

1. Architect will not review submittals that include MSDSs and will return the entire submittal for resubmittal.

2.3 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S / ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. Reviewed, Furnish as Corrected, Rejected, Revise and Resubmit, and Submit Specific Item.

C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:
1. Division 01 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
2. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where

indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.

D. Dental Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.

E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

J. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as

appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

C. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

H. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor.

Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed, unless otherwise indicated.

J. Dental Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 02 through 49.

1.7 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.

3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect**,** and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for commencement of the Work.

1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.8 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

B. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect**,**] with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ACCEPTABLE TESTING AGENCIES

A. S.W. Cole or other architect and structural engineer approvals.

3.2 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.3 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if

bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl1

ADAAG	Americans with Disabilities Act (ADA)	(800) 872-2253
	Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities	(202) 272-0080
	Available from Access Board www.access-board.gov	
CFR	Code of Federal Regulations	(888) 293-6498
	Available from Government Printing Office	(202) 512-1530
	www.gpoaccess.gov/cfr/index.html	
CRD	Handbook for Concrete and Cement	(601) 634-2355
	Available from Army Corps of Engineers Waterways Experiment Station www.wes.army.mil	
DOD	Department of Defense Military Specifications and Standards	(215) 697-6257
	Available from Department of Defense Single Stock Point www.dodssp.daps.mil	
DSCC	Defense Supply Center Columbus (See FS)	
FED-STD	Federal Standard (See FS)	
FS	Federal Specification	(215) 697-

		6257
	Available from Department of Defense Single Stock Point www.dodssp.daps.mil	
	Available from General Services Administration	(202) 501-1021
	www.fss.gsa.gov	
	Available from National Institute of Building Sciences	(202) 289-7800
	www.nibs.org	
FTMS	Federal Test Method Standard (See FS)	
ICC-ES	ICC Evaluation Service, Inc.	(800) 423-6587
	www.icc-es.org	(562) 699-0543
MIL	(See MILSPEC)	
MIL-STD	(See MILSPEC)	
MILSPEC	Military Specification and Standards	(215) 697-6257
	Available from Department of Defense Single Stock Point www.dodssp.daps.mil	
NES	(Formerly: National Evaluation Service) (See ICC-ES)	
UFAS	Uniform Federal Accessibility Standards	(800) 872-2253
	Available from Access Board	(202) 272-0080
	www.access-board.gov	

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale Research's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl2

AA	Aluminum Association, Inc. (The) www.aluminum.org	(202) 862-5100
AAADM	American Association of Automatic Door Manufacturers www.aaadm.com	(216) 241-7333
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists (The) www.aatcc.org	(919) 549-8141
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 367-1155
ACI	ACI International (American Concrete Institute) www.aci-int.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700
AGA	American Gas Association www.aga.org	(202) 824-7000
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AHA	American Hardboard Association (Now part of CPA)	
AHAM	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The)	(800) 242-3837

	www.aia.org	(202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
ALCA	Associated Landscape Contractors of America www.alca.org	(800) 395-2522 (703) 736-9666
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	Association of Official Seed Analysts www.aosaseed.com	(505) 522-1437
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (The American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (212) 591-7722

ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9585
AWCI	AWCI International (Association of the Wall and Ceiling Industries International) www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (Now WCSC)	
AWI	Architectural Woodwork Institute www.awinet.org	(800) 449-8811 (703) 733-0600
AWPA	American Wood-Preservers' Association www.awpa.com	(334) 874-9800
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
BICSI	BICSI www.bicsi.org	(813) 979-1991
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International) www.bifma.com	(616) 285-3963
BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(773) 761-4100
	Cast Stone Institute www.caststone.org	(770) 972-3011
CCC	Carpet Cushion Council www.carpetcushion.org	(203) 637-1312
CDA	Copper Development Association Inc.	(800) 232-3282

	www.copper.org	(212) 251-7200
CEA	Canadian Electricity Association www.canelect.ca/connections_online/home.htm	(613) 230-9263
CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CGSB	Canadian General Standards Board w3.pwgsc.gc.ca/cgsb	(800) 665-2472 (819) 956-0425
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CPA	Composite Panel Association www.pbmdf.com	(301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association www.cppa-info.org	(800) 510-2772 (202) 462-9607
CRI	Carpet & Rug Institute (The) www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(800) 463-6727 (416) 747-4000
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau www.cedarbureau.org	(604) 820-7700
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) www.cti.org	(281) 583-4087

DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (770) 968-7945
EJCDC	Engineers Joint Contract Documents Committee www.asce.org	(800) 548-2723 (703) 295-6300
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association www.esda.org	(315) 339-6937
FCI	Fluid Controls Institute www.fluidcontrolsinstitute.org	(216) 241-7333
FIBA	Federation Internationale de Basketball Amateur (The International Basketball Federation) www.fiba.com	41 22 545 00 00
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation) www.fivb.ch	41 21 345 35 35
FM	Factory Mutual System (Now FMG)	
FMG	FM Global (Formerly: FM - Factory Mutual System) www.fmglobal.com	(401) 275-3000
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc. www.floridaroof.com	(407) 671-3772
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council www.fsc.org	52 951 5146905
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GANA	Glass Association of North America	(785) 271-0208

	www.glasswebsite.com	
GRI	(Now GSI)	
GS	Green Seal www.greenseal.org	(202) 872-6400
GSI	Geosynthetic Institute www.geosynthetic-institute.org	(610) 522-8440
HI	Hydraulic Institute www.pumps.org	(888) 786-7744 (973) 267-9700
HI	Hydronics Institute www.gamanet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IAS	International Approval Services (Now CSA International)	
IBF	International Badminton Federation www.intbadfed.org	441-24 223-4904
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 646-2234
IGMA	Insulating Glass Manufacturers Alliance (The) www.igmaonline.org	(613) 233-1510

ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426
ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(702) 567-8150
ITS	Intertek www.intertek.com	(800) 345-3851 (607) 753-6711
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LMA	Laminating Materials Association (Now part of CPA)	
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864 (847) 577-7200
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MFMA	Maple Flooring Manufacturers Association www.maplefloor.org	(847) 480-9138
MFMA	Metal Framing Manufacturers Association www.metalframingmfg.org	(312) 644-6610
MH	Material Handling (Now MHIA)	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers	(312) 332-0405

	www.naamm.org	
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(281) 228-6200
NADCA	National Air Duct Cleaners Association www.nadca.com	(202) 737-2926
NAGWS	National Association for Girls and Women in Sport www.aahperd.org/nagws/	(800) 213-7193 ext. 453
NAIMA	North American Insulation Manufacturers Association (The) www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCAA	National Collegiate Athletic Association (The) www.ncaa.org	(317) 917-6222
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	(262) 248-9094
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-3550
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(303) 697-8441
NFHS	National Federation of State High School Associations www.nfhs.org	(317) 972-6900
NFPA	NFPA (National Fire Protection Association)	(800) 344-3555 (617) 770-3000

	www.nfpa.org	
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NGA	National Glass Association www.glass.org	(703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOFMA	National Oak Flooring Manufacturers Association www.nofma.org	(901) 526-5016
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. www.ntma.com	(800) 323-9736 (540) 751-0930
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)	
NWWDA	National Wood Window and Door Association (Now WDMA)	
OPL	Omega Point Laboratories, Inc. www.opl.com	(800) 966-5253 (210) 635-8100
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDCA	Painting & Decorating Contractors of America www.pdca.com	(800) 332-7322 (314) 514-7322
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720

PGI	PVC Geomembrane Institute http://pgi-tp.ce.uiuc.edu	(217) 333-3929
PTI	Post-Tensioning Institute www.post-tensioning.org	(602) 870-7540
RCSC	Research Council on Structural Connections www.boltcouncil.org	(800) 644-2400 (312) 670-2400
RFCI	Resilient Floor Covering Institute www.rfci.com	(301) 340-8580
RIS	Redwood Inspection Service www.calredwood.org	(888) 225-7339 (415) 382-0662
RTI	(Formerly: NTRMA - National Tile Roofing Manufacturers Association) (Now TRI)	
SAE	SAE International www.sae.org	(724) 776-4841
SDI	Steel Deck Institute www.sdi.org	(847) 462-1930
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(516) 294-5424
SEI	Structural Engineering Institute www.seinstitute.com	(800) 548-2723 (703) 295-6195
SGCC	Safety Glazing Certification Council www.sgcc.org	(315) 646-2234
SIA	Security Industry Association www.siaonline.org	(703) 683-2075
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)	
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association www.smacentral.org	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association	(703) 803-2980

	www.smacna.org	
SMPTE	Society of Motion Picture and Television Engineers www.smpte.org	(914) 761-1100
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division) www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau (The) www.spib.org	(850) 434-2611
SPI/ SPFD	Society of the Plastics Industry, Inc. (The) Spray Polyurethane Foam Division (Now SPFA)	
SPRI	SPRI (Single Ply Roofing Institute) www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974
TCA	Tile Council of America, Inc. www.tileusa.com	(864) 646-8453
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
TPI	Truss Plate Institute, Inc. www.tpinst.org	(608) 833-5900
TPI	Turfgrass Producers International www.turfgrasssod.org	(800) 405-8873 (847) 705-9898

TRI	Tile Roofing Institute (Formerly: RTI - Roof Tile Institute) www.tileroofing.org	(312) 670-4177
UL	Underwriters Laboratories Inc. www.ul.com	(800) 285-4476 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USAV	USA Volleyball www.usavolleyball.org	(888) 786-5539 (719) 228-6800
USGBC	U.S. Green Building Council www.usgbc.org	(202) 828-7422
USITT	United States Institute for Theatre Technology, Inc. www.usitt.org	(800) 938-7488 (315) 463-6463
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association (Now WCSC)	
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association) www.windowcoverings.org	(800) 506-4636 (212) 661-4261
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California) www.wicnet.org	(916) 372-9943
WIC	Woodwork Institute of California (Now WI)	
WMMPA	Wood Moulding & Millwork Producers Association www.wmmpa.com	(800) 550-7889 (530) 661-9591
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 548-0112

WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl3

BOCA	BOCA International, Inc. (See ICC)	
CABO	Council of American Building Officials (See ICC)	
IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICBO	International Conference of Building Officials (See ICC)	
ICBO ES	ICBO Evaluation Service, Inc. (See ICC-ES)	
ICC	International Code Council (Formerly: CABO - Council of American Building Officials) www.iccsafe.org	(703) 931-4533
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543
NES	National Evaluation Service (See ICC-ES)	
SBCCI	Southern Building Code Congress International, Inc. (See ICC)	

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl4

CE	Army Corps of Engineers www.usace.army.mil	
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-6816

DOC	Department of Commerce www.commerce.gov	(202) 482-2000
DOD	Department of Defense www.dodssp.daps.mil	(215) 697-6257
DOE	Department of Energy www.eren.doe.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(202) 366-4000
FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
FDA	Food and Drug Administration www.fda.gov	(888) 463-6332
GSA	General Services Administration www.gsa.gov	(800) 488-3111 (202) 501-1888
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
LBL	Lawrence Berkeley National Laboratory www.lbl.gov	(510) 486-4000
NCHRP	National Cooperative Highway Research Program (See TRB)	
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
PBS	Public Building Service (See GSA)	
PHS	Office of Public Health and Science http://phs.os.dhhs.gov	(202) 690-7694
RUS	Rural Utilities Service (See USDA)	(202) 720-9540
SD	State Department www.state.gov	(202) 647-4000

TRB	Transportation Research Board www.nas.edu/trb	(202) 334-2934
USDA	Department of Agriculture www.usda.gov	(202) 720-2791
USPS	Postal Service www.usps.com	(202) 268-2000

E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl5

CBHF	State of California, Department of Consumer Affairs	(800) 952-5210
	Bureau of Home Furnishings and Thermal Insulation www.dca.ca.gov/bhfti	(916) 574-2041
CPUC	California Public Utilities Commission www.cpuc.ca.gov	(415) 703-2782
TFS	Texas Forest Service Forest Products Laboratory http://txforestservice.tamu.edu	(936) 639-8180

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01420

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Sections include the following:

1. Division 01 Section "Summary" for limitations on utility interruptions and other work restrictions.
2. Division 01 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
3. Division 01 Section "Execution" for progress cleaning requirements.
4. Divisions 02 through 49 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.
5. Division 32 Section "Dewatering" for disposal of ground water at Project site.
6. Division 31 Section "Asphalt Paving" for construction and maintenance of asphalt paving for temporary roads and paved areas.
7. Division 32 Section "Concrete Paving" for construction and maintenance of cement concrete pavement for temporary roads and paved areas.

1.3 DEFINITIONS

A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer service use charges for sewer usage by all entities for construction operations.

C. Sewer, Water, and Electric Power Service: Use charges are specified in Division 01 Section "Multiple Contract Summary."

D. Water Service: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

E. Electric Power Service: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.5 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.6 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.7 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pavement: Comply with Division 32 pavement Sections.

B. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.76-mm-) thick, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts.

C. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide concrete or galvanized steel bases for supporting posts.

D. Wood Enclosure Fence: Plywood, 6 feet (1.8 m) high, framed with four 2-by-4-inch (50-by-100-mm) rails, with preservative-treated wood posts spaced not more than 8 feet (2.4 m) apart.

E. All wood products, project-wide: Use a minimum of 50% of wood-based materials and products, which are certified in accordance with the Forest Stewardship Council's (FSC) Principle and Criteria for wood building components. These components include, but are not limited to, temporary fencing, structural framing and general dimensional framing, flooring, sub-flooring, wood doors and finishes.

F. Lumber and Plywood: Comply with requirements in Division 06 Section "Rough Carpentry."

G. Gypsum Board: Minimum 1/2 inch (12.7 mm) thick by 48 inches (1219 mm) wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36/C 36M.

H. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

I. Paint: Comply with requirements in Division 09 painting Sections.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room is not required. Meetings will be held in a UNE classroom to be determined.
3. Coffee machine and supplies.
4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
5. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

F. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from

adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

H. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.

I. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service as directed by owner, unless otherwise indicated.
2. Connect temporary service to Owner's existing power source, as directed by Owner.

J. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
2. Install lighting for Project identification sign.

K. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.

1. Provide additional telephone lines for the following:

    a. Provide a dedicated telephone line for each facsimile machine and computer in each field office.

2. At each telephone, post a list of important telephone numbers.

    a. Police and fire departments.
    b. Ambulance service.
    c. Contractor's home office.
    d. Architect's office.
    e. Engineers' offices.
    f. Owner's office.
    g. Principal subcontractors' field and home offices.

3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

L. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail, in common-use facilities.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.
2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas in same location as permanent roads and paved areas. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 31 Section "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 32 Section "Asphalt Paving."

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Use designated areas of Owner's existing parking areas (Construction Site or lower level of campus) for construction personnel.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Identification and Temporary Signs: Provide Project identification and other signs as indicated on Drawings. Signs can go up as early as groundbreaking. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.

1. Provide temporary, directional signs for construction personnel and visitors.
2. Maintain and touchup signs so they are legible at all times.

G. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.

I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

J. Temporary Elevator Use: Refer to Division 14 Sections for temporary use of new elevators.

K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

L. Temporary Use of Permanent Stairs: Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Division 01 Section "Summary."

B. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Division 31 Section "Site Clearing."

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Comply with requirements specified in Division 01 Section "Temporary Tree and Plant Protection."

F. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner with one set of keys.

H. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

K. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.

D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. Related Sections include the following:
   1. Division 01 Section "Alternates" for products selected under an alternate.
   2. Division 01 Section "References" for applicable industry standards for products specified.
   3. Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
   4. Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility**,** except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.4 SUBMITTALS

A. Product List: Submit a list, in tabular from, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.

1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
2. Form: Tabulate information for each product under the following column headings:

a. Specification Section number and title.
b. Generic name used in the Contract Documents.
c. Proprietary name, model number, and similar designations.
d. Manufacturer's name and address.
e. Supplier's name and address.
f. Installer's name and address.
g. Projected delivery date or time span of delivery period.
h. Identification of items that require early submittal approval for scheduled delivery date.

3. Initial Submittal: Within 15days after date of commencement of the Work, submit **3** copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.

a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.

4. Completed List: Within 15 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
5. Architect's Action: Architect will respond in writing to Contractor within 15 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.

B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use **CSI Form 13.1A**.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified material or product cannot be provided.
b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within **7** days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within **7** days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

a. Form of Acceptance: Change Order.
b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

C. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."

b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.

D. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
3. Refer to Divisions 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

    a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.

10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.

    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.
10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.3 COMPARABLE PRODUCTS

A. Conditions: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

B. Related Sections include the following:

1. Division 01 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 01 Section "Submittal Procedures" for submitting surveys.
3. Division 01 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
4. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 SUBMITTALS

A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

C. Certified Surveys: Submit two copies signed by land surveyor.

D. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

a. Description of the Work.
b. List of detrimental conditions, including substrates.
c. List of unacceptable installation tolerances.
d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
3. Inform installers of lines and levels to which they must comply.
4. Check the location, level and plumb, of every major element as the Work progresses.
5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
4. Maintain minimum headroom clearance of 8 feet (2.4 m) in spaces without a suspended ceiling.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction forces.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:
   1. Divisions 2 through 49 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
   2. Division 07 Section "Penetration Firestopping" for patching fire-rated construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least two (2) days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

   1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
   2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
   3. Products: List products to be used and firms or entities that will perform the Work.
   4. Dates: Indicate when cutting and patching will be performed.
   5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.

6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operating elements include the following:

1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Fire-suppression systems.
4. Mechanical systems piping and ducts.
5. Control systems.
6. Communication systems.
7. Conveying systems.
8. Electrical wiring systems.
9. Operating systems of special construction in Division 13 Sections.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior curtain-wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface

containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Warranties.
3. Final cleaning.

B. Related Sections include the following:
1. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
2. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.

10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Architect.
d. Name of Contractor.
e. Page number.

1.6 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations. All cleaning practices must follow the procedures and requirements outlined in the Construction IAQ Management Plan:. Refer to Section 013550 Construction Indoor Air Quality.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

k. Remove labels that are not permanent.
l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Replace parts subject to unusual operating conditions.
o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
q. Clean ducts, blowers, and coils if units were operated without filters during construction.
r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
s. Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

SECTION 017823

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Operation and maintenance documentation directory.
   2. Operation manuals for systems, subsystems, and equipment.
   3. Maintenance manuals for the care and maintenance of products, materials, and finishes, systems and equipment.

B. Related Sections include the following:
   1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
   2. Division 1 Section "Closeout Procedures" for submitting operation and maintenance manuals.
   3. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
   4. Divisions 2 through 16 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

A. Final Submittal: Submit one copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments after final inspection.
   1. Correct or modify each manual to comply with Architect's comments. Submit corrected manual within 15 days of receipt of Architect's comments.

1.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:
   1. List of documents.

2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name, address, and telephone number of Contractor.
6. Name and address of Architect.
7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
   a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
   b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in

the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:
1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:
1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard printed maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training videotape, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
   1. Do not use original Project Record Documents as part of operation and maintenance manuals.
   2. Comply with requirements of newly prepared Record Drawings in Division 1 Section "Project Record Documents."

G. Comply with Division 1 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01782

SECTION 017839

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.

B. Related Sections include the following:
   1. Division 1 Section "Closeout Procedures" for general closeout procedures.
   2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   3. Divisions 2 through 16 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit copies of Record Drawings as follows:
      a. Submit one set(s) of marked-up Record Prints
         1) Electronic Media: One PDF copy, CD-R.

B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one copy of each Product Data submittal.
   1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
   1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Accurately record information in an understandable drawing technique.
      c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:
   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations below first floor.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
   j. Changes made by Change Order or Construction Change Directive.
   k. Changes made following Architect's written orders.
   l. Details not on the original Contract Drawings.
   m. Field records for variable and concealed conditions.
   n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize Record Prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Each subcontractor shall keep track of field conditions daily, and record changes on record set kept at Design-Builder's job trailer. Record documents shall be maintained and current with each subcontractor's application of payment.

C. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 01781

SECTION 017900

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.
   3. Demonstration and training videotapes.

B. Related Sections include the following:
   1. Division 1 Section "Project Management and Coordination" for requirements for preinstruction conferences.
   2. Divisions 2 through 16 Sections for specific requirements for demonstration and training for products in those Sections.

1.03 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
   1. HVAC systems, including instrumentation and controls.
   2. HVAC instrumentation and controls.
   3. Electrical service and distribution, including switchboards, and panelboards.
   4. Lighting equipment and controls.
   5. Communication systems, including voice and data equipment.

B. Training: Develop a learning objective and teaching outline. Include instruction as applicable for the following:
   1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
      a. System, subsystem, and equipment descriptions.
      b. Performance and design criteria if Contractor is delegated design responsibility.
      c. Operating standards.

d. Regulatory requirements.
e. Equipment function.
f. Operating characteristics.
g. Limiting conditions.
h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project Record Documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.
5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.
8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.01 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.

B. Set up instructional equipment at instruction location.

3.02 INSTRUCTION

A. Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner with at least fourteen days' advance notice.

3.03 DEMONSTRATION AND TRAINING VIDEO

A. General: Provide manufacturer’s standard prepared training videos, if available..

END OF SECTION 01820

1.1

SECTION 02 01 00

EXISTING UTILITES AND STRUCTURES

PART 2 - GENERAL

2.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2.2 SUMMARY

A. This Section includes protecting and coordinating with existing utilities and underground structures.

2.3 DESCRIPTION

A. The existing utilities and underground structures shown on the drawings are shown diagrammatically and it is not to be inferred that the locations shown are precise.

B. The Contractor shall coordinate with all applicable utility owners prior to excavation in areas where it is reasonable to expect the presence of existing utilities, whether shown on the drawings or not.

C. Contractor to coordinate with a utility locator service provider to locate underground utilities before the start of construction.

D. The Contractor shall be responsible to pay for any and all damages to any existing utilities and underground structures, caused by his efforts. The utility shall make the determination as to who makes the necessary repairs.

E. If any such damage should occur the Contractor shall contact the effected utility and the Owner’s Representative immediately.

F. In areas where existing underground structures are shown or suspected carefully uncover such structures to such extent as to enable the Owner's Representative to determine what adjustments if any need to be made to accommodate the presence or removal of such structure.

2.4 UTILITIES

A. Arrange for disconnecting and sealing indicated utilities that serve existing structures before site excavation, demolition and clearing.

B. Locate, identify, disconnect, and seal or cap off utilities.

1. Arrange with utility providers to shut off appropriate utilities.

C. Provide notification to Owner's Representative and utility provider five days prior to any interruption of service. Do not proceed without receiving written authorization to do so.

D. Arrange to provide temporary utility services if indicated or deemed necessary by the Owner or the utility provider.

E. Excavate, remove, and backfill underground utilities to be removed.

F. Excavate, cap and seal, and backfill underground utilities to be abandon in place.

G. Existing sewer service to be abandoned. Disconnect at street right of way line. Seal at right of way and main. Remove on site portion, from right of way into the site.

H. Existing water service to be abandoned. Disconnect at the main and cap. Disconnect at the right of way and cap. Remove portion from right of way into the site.

PART 3 - PRODUCTS (Not Used)

PART 4 - EXECUTION (Not Used)

END OF SECTION

SECTION 02 32 00

GEOTECHNICAL INVESTIGATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Geotechnical Report as prepared by Summit Geoengineering Services, dated January 2012 is an integral part of these specifications. Should any discrepancies arise between these specifications and the Geotechnical Report, said report shall govern. The contractor shall notify the Owner's Representative if any such discrepancies arise. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the report.

1.2 DESCRIPTION

A. Subsurface investigations have been done at the location of the project and a report has been compiled for the purpose of guidance in the design of the project facilities. These investigations may include open excavation test pits, observation wells soil borings and other related investigations

B. The investigations are not intended to indicate subsurface conditions except at the locations of the exploration as observed at the time explorations were made and any interpretation the Contractor may make is his responsibility. Contractor to make additional test borings and conduct other exploratory operations as necessary for design of excavation support and protection or as otherwise needed to verify existing conditions.

C. The reports present the opinion of the Geotechnical Engineer and shall not be interpreted to prescribe or dictate construction procedures or relieve the Contractor in any way of his responsibility for the construction.

D. The water levels indicated at the exploration locations are based on observations made by the Field personnel at the same time the explorations were made and may or may not represent the groundwater surface in the immediate vicinity of the explorations. They are presented only as an observation of the free-standing water surface in the exploration on the date noted.

E. The refusal depths shown at the exploration locations indicate only, that in the drill foreman's opinion, sufficient resistance to the advance of the casing, auger, probe rod or sampler was encountered to render further advance impossible or impractical by the procedures and equipment being used. Although refusal may indicate the encountering of the bedrock surface, it may indicate the striking of large cobbles, boulders, very dense or cemented soil, or other buried natural or man- made objects or it may indicate the encountering of a harder zone after penetrating a considerable depth through a weathered or disintegrated zone of the bedrock.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 02 41 13

SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Demolition and removal of site buildings, features and utilities.
2. Disconnecting, capping or sealing, and abandoning in-place site utilities as indicated.
3. Disconnecting, capping or sealing, and removing site utilities as indicated.
4. Salvaging items for reuse by Owner.
5. Hazardous materials

B. Related Sections include the following:

1. Division 01 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities
2. Division 2 Section “Existing Utilities and Underground Structures” for existing utilities and underground structures.
3. Division 22 Section: “Plumbing” for additional utility requirements
4. Division 26 Section: “Electrical” for addition utility requirements
5. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
6. Division 31 Section "Site Clearing" for site clearing and grubbing, stripping topsoil and the protection and removal of landscape and site features.
7. Division 31 Section "Erosion and Sedimentation Control" for temporary erosion and sedimentation control measures.

C. References Included in this Section:

1. NFPA – National Fire Protection Agency.
2. ANSI – American National Standards Institute.
3. EPA – Environmental Protection Agency

1.3 DEFINITIONS

A. Demolish: Completely remove and legally dispose of off-site.

B. Hazardous Materials: Any solid, liquid, or gas that can harm people, other living organisms, property, or the environment. Hazardous Materials may be radioactive, flammable, explosive, toxic, corrosive, biohazardous, an oxidizer, an asphyxiant, a pathogen, an allergen, or may have other characteristics that render it hazardous in specific circumstances.

C. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.

D. Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated or directed by the Owner's Representative all demolition waste becomes property of Contractor. It shall be removed from the site and salvaged or disposed of an accord will all applicable laws, ordinances and other requirements.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

C. All items indicated on the drawings to be "Salvage" shall remain the property of the Owner and stored and delivered per direction of Owner's Representative.

1.5 SUBMITTALS

A. Schedule of Site Demolition Activities: Indicate the following:

1. Detailed sequence of demolition work, with starting and ending dates for each activity.
2. Temporary interruption of utility services.
3. Shutoff and capping of utility services.

B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI A10.6 and NFPA 241.

1.7 PROJECT CONDITIONS

A. Facilities to be demolished will be vacated and their use discontinued before start of the Work.

B. Conduct site demolition so operations of adjacent occupied buildings will not be disrupted.

1. Provide not less than 5 days notice of activities that will affect operations of adjacent buildings or facilities.
2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.

a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction and Owner's Representative.

C. Owner assumes no responsibility for building structures and utilities to be demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
2. Before site demolition, Owner will remove wanted items.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. The Contractor shall be alert to the possibility of uncovering unknown and possibly hazardous materials during the course of demolition and construction. If any materials are encountered which appear potentially hazardous, do not disturb, stop work in suspected area immediately and notify the Owner's Representative for review of situation and development of appropriate action plan.

E. On-site storage of removed items or materials is not permitted without the permission of the Owner's Representative.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions of said items prior to and after removal to document condition.

D. Verify that hazardous materials have been remediated before proceeding with site demolition operations.

3.2 PREPARATION

NTS: If Division 02 Section "Existing Utilities & Underground Structures" is included, as part of these specifications, delete the following Paragraph. If not included Delete paragraph B.

Divisions 02"Existing Utilities & Underground Structures" is included use the following paragraph. If not use paragraph A and delete the following.

A. Existing Utilities: Refer to Divisions 02 "Existing Utilities & Underground Structures" for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing from the Owner's Representative and appropriate utility providers.

B. Salvaged Items: Comply with the following:

1. Clean salvaged items of dirt and demolition debris.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to storage area indicated on Drawings or as directed by the Owner's Representative.
5. Protect items from damage during transport and storage.

3.3 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings at all times.

B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations. No existing utility service will be interrupted without written approval from the Owner's Representative.

C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by the Owner and or the authorities having jurisdiction and as indicated. Comply with requirements in Division 01 Section "Temporary Facilities and Controls."

1. Protect adjacent buildings and facilities from damage due to demolition activities.
2. Protect existing site improvements, appurtenances, and landscaping to remain.
3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
4. Provide temporary barricades, fencing and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.4 DEMOLITION, GENERAL

A. General: Demolish indicated existing buildings, site structures, and site improvements completely or to the limits indicated on the drawings. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
2. Maintain fire watch during and for at least 8 hours after flame cutting operations.
3. Maintain adequate ventilation when using cutting torches.
4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

C. Explosives: Use of explosives is not permitted without expressed written consent by Owner

D. Salvage: Items to be salvaged are indicated on Drawings.

E. Below-Grade Construction: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extend outside footprint indicated for new construction.
1. Remove below-grade construction, including basements, foundation walls, and footings, in their entirety.

F. Demolish and remove existing utilities and below-grade utility structures.

1. Backfill with approved soil materials and placement thereof according to backfill requirements in Division 31 Section "Earth Moving."

3.5 SITE RESTORATION

A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with acceptable materials according to backfill requirements in Division 31 Section "Earth Moving."

B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.6 REPAIRS

A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and legally dispose of them in an EPA-approved landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION

SECTION 03 30 00 – CAST -IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The drawings and general conditions of the contract including General and Supplementary Conditions and other Division 1 Specification sections apply to work of this section.

B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK:

A. Work included: Provide labor, materials, and equipment necessary to complete the work of this Section and, without limiting the generality thereof, furnish and include the following:

1. The extent of cast-in-place concrete work is shown on drawings and includes (but not by way of limitation) formwork, reinforcing, cast-in-place concrete, accessories, finishing, and casting in of items specified under other Sections of the Specifications or furnished by Owner that are required to be built-in with the concrete.

2. Equipment support pads indicated on mechanical drawings to be installed by the Building Contractor.

3. Cast-in-place retaining walls, exterior slabs on grade and other concrete shown on site drawings.

1.03 RELATED WORK:

A. Metal Fabrications: Section 05 50 00

1. Expansion Anchors – Section 05 12 00

2. Embedded Items - Section 05 50 00

B. Anchor Bolts: Section 05 12 00

C. Joint Sealants: Division 7

D. Underslab Vapor Retarders/Wall Waterproofing: Division 7

1.04 QUALITY ASSURANCE:

A. Codes and Standards: Comply with provisions of the latest edition of the following except where more stringent requirements are shown or specified:

1. ACI “Manual of Concrete Practice”.
2. ACI 117 “Standard Specifications for Tolerances for Concrete Construction and Materials”.
3. ACI 211.1 "Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete."
4. ACI 212.3R "Chemical Admixtures for Concrete."
5. ACI 301 "Specifications for Structural Concrete for Buildings."
6. ACI 302.1R "Guide for Concrete Floor and Slab Construction."
7. ACI 304R "Guide for Measuring, Mixing, Transporting and Placing Concrete."
8. ACI 304.2R "Placing Concrete by Pumping Methods."
9. ACI 306 R "Cold Weather Concreting."
10. ACI 308 “Standard Practice for Curing Concrete."
11. ACI 309R "Guide for Consolidation of Concrete."
12. ACI 315 "ACI Detailing Manual."
13. ACI 318 "Building Code Requirements for Reinforced Concrete."
14. ACI 347R "Guide to Formwork for Concrete."
15. Concrete Reinforcing Steel Institute, "Placing Reinforcing Bars."
16. AISC “Code of Standard Practice for Steel Buildings and Bridges.”
17. “Code of Federal Regulations, Part 1926” per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).

B. Materials and installed work may require testing and retesting, as directed by the Architect, at any time during progress of work. Allow free access to material stockpiles and facilities. Tests not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.

1.05 SUBMITTALS:

A. Unless otherwise specified, submittals required in this section shall be submitted for review. Submittals shall be prepared and submitted in accordance with Division 1.

B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner’s Notice to Proceed.

C. All submittals shall be reviewed and returned to the Architect within 10 working days.

D. Incomplete submittals will not be reviewed.

E. Submittals not reviewed by the General Contractor prior to submission to the Engineer will not be reviewed. Include on the submittal statement or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with.

F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.

G. Hardcopy Submittals: Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.

H. Electronic Submittals:

1. Contractor shall include in the submittal schedule an indication of submittals that are intended to be submitted electronically. Upon receipt of the submittal schedule, the Engineer reserves the right to indicate submittals that will not be accepted electronically. Paper copies of such submittals shall be furnished as referenced in this specification.

2. The Engineer reserves the right to require paper copies of submittals that are received electronically. Provide Engineer one (1) paper copies in addition to the electronic submittal. Paper copy will be retained and electronic copy will be returned. Review cycle for such submittals shall not commence until such time that the paper copies are received.

3. Electronic Submittals shall be submitted in Protected Document Format (PDF) compatible with Adobe Acrobat Professional version 7.0 or later. Electronic files shall not be broken into smaller individual files. File sizes too large to process email or within a file transfer protocol (FTP) site shall be provided on a CD.

4. The submission of submittals electronically does not relieve the contractor of their responsibility to review the submittal prior to transmission to the Engineer. Electronic Submittals shall include contractor comments, and a statement and/or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with. Electronic submittals without the Contractor's approval will be rejected and returned.

5. The Engineer assumes no responsibility for the printed reproduction of submittals reviewed electronically, transmission errors or returned electronic submittals that become corrupted or are otherwise not accessible by the Contractor's or Subcontractor's computer hardware and/or software.

I. Product Data: Submit producer's or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

1. Reinforcement certified mill reports covering chemical and physical properties and yield strength.

2. Patching products.

3. Non-shrink grout.

4. Curing compounds, where applicable.

5. Admixtures.

6. Expansion/Adhesive Anchors.

J. Shop Drawings:

1. Shop Drawing Preparation: Electronic files of structural drawings will not be provided to the contractor for preparation of shop drawings. Reproduction of any portion of the Construction Documents for use as Shop drawings is prohibited. Shop drawings created from reproduced Construction Documents will be returned without review. Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI 315, showing bar schedules, stirrup and tie spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required at openings through concrete elements. Include supplemental reinforcing and bar supports necessary to support reinforcing steel at proper location within forms or slabs.

a. Review of the shop drawings will be made for the size and arrangement of reinforcement. Conformance of the Shop Drawings to the Contract Drawings remains the responsibility of the General Contractor. Engineer's review in no way relieves the General Contractor of this responsibility.

b. Shop drawings will not be reviewed as partial submittals. A complete submittal shall be provided all items listed prior. **Incomplete submittals will not be reviewed.**

K. Mix designs: Submit all laboratory test reports and materials for each mix design listed within. Prepare mixes by the field experience method and/or trial mixtures per the requirements of chapter 5 of ACI 318. Include the calculation of average strength and standard deviation. Proportioning by water cement ratio method will not be permitted.

L. Samples: Submit samples of materials as specified and as otherwise requested by Architect, including names, sources and descriptions.

M. Curing Methods: Submit documentation of curing methods to be used for review. Account for anticipated project temperature ranges and conditions in curing methods.

N. Contraction/Construction Joints: Submit plan indicating proposed location of contraction and construction joints in walls and slabs.

O. Test Reports: Test reports shall be submitted to the Owner, Architect and Engineer within 48 hour after completion of each test.

PART 2 - PRODUCTS

2.01 FORM MATERIALS:

A. Forms for Exposed Finish Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.

1. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edge-sealed, with piece bearing legible inspection trademark.

B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

2.02 REINFORCING MATERIALS:

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Welded Wire Fabric: ASTM A 185, welded steel wire fabric. Provide welded wire fabric in flat sheets.

C. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use plastic, wire bar type supports or concrete block supports complying with CRSI recommendations, unless otherwise specified. Wood, clay brick and other unspecified devices are not acceptable.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class I) or stainless steel protected (CRSI, Class 2).

2.03 CONCRETE MATERIALS:

A. Single-Source Supplier: Ready-mix concrete shall be from one supplier unless specific written approval is received from the Structural Engineer.

B. Portland Cement: ASTM C 150, Type I or Type II, unless otherwise approved Use one brand of cement throughout project, unless otherwise acceptable to Architect.

C. Normal Weight Aggregates: ASTM C 33. Provide from a single source for exposed concrete. Do not use aggregates containing soluble salts or other substances such as iron sulfides, pyrite, marcasite, or ochre which can cause stains on exposed concrete surfaces.

D. Light Weight Aggregates: ASTM C 330.

E. Water: Potable.

F. Air-Entraining Admixture: ASTM C 260.

G. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G containing not more than 1% chloride ions.

H. Fiber reinforcement shall be Type III Synthetic Virgin Homopolymer Polypropylene Fibers conforming to ASTM C1116. Fiber reinforcing shall be added and distributed prior to incorporation of Super Plasticizer.

I. Normal range water reducing admixture: ASTM C 494 Type A containing no calcium chloride.

J. Accelerating Admixture: ASTM C 494, Type C or E.

K. Blast Furnace Slag: ASTM C989

L. Fly Ash: ASTM C618, Class C or F

M. Calcium Chloride is not permitted.

2.04 RELATED MATERIALS:

A. Underslab Vapor Retarder: Provide vapor retarder over prepared sub base. Refer to architectural drawings, geotechnical report and/or division 7 specifications for additional requirements and vapor retarder location.

B. Non-Shrink Cement-based Grout: Provide grout consisting of pre-measured, prepackaged materials supplied by the manufacturer requiring only the addition of water. Manufacturer's instructions must be printed on the outside of each bag.

1. Non-shrink: No shrinkage (0.0%) and a maximum 4.0% expansion when tested in accordance with ASTM C-827. No shrinkage (0.0%) and a maximum of 0.3% expansion in the hardened state when tested in accordance with CRD-C-621.

2. Compressive strength: A minimum 28 day compressive strength of 5000 psi when tested in accordance with ASTM C-109.

3. Setting time: A minimum initial set time of 60 minutes when tested in accordance with ASTM C-191.

4. Composition: Shall not contain metallic particles or expansive cement.

C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M182, Class 2.

D. Moisture-Retaining Cover: One of the following, complying with ANSI/ASTM C 171.

1. Waterproof paper.

2. Polyethylene film.

3. Polyethylene-coated burlap.

E. Liquid Membrane-Forming Curing Compound: Liquid type membrane forming curing compound complying with ASTM C 309, Type I, Class A unless other type acceptable to Architect. Curing compound shall not impair bonding of any material, including floor finishes, to be applied directly to the concrete. Demonstrate the non-impairment prior to use.

F. Preformed Expansion Joint Formers:

1. Bituminous Fiber Type, ASTM D 1751.

2. Felt Void, Poly-Styrene Cap with removable top as manufactured by SUPERIOR.

G. Slab Joint Filler: Multi-component polyurethane sealant (self-leveling type).

H. Waterstops shall be Bentonite/Butyl Rubberbased product. Use in conjunction with manufacturer’s approved mastic. Acceptable products include:

1. “Waterstop Rx,” by American Colloid Co.

2. "Adeka Ultra Seal MC-2010," by Asahi Denka Koeyo, Kik MN.

2.05 PROPORTIONING AND DESIGN OF MIXES:

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 318. Use material, including all admixtures, proposed for use on the project. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing unless otherwise acceptable to Architect.

B. Submit written reports to Architect of each proposed mix for each class of concrete. Do not begin concrete production until mixes have been reviewed by Architect.

C. Proportion design mixes to provide concrete with the following properties:

1. Footings and foundation walls

a. Strength: 3,000 psi at 28 days.

b. Aggregate: 3/4"

c. W/C Ratio: 0.54 maximum

d. Entrained Air: 6% +/- 1.5%

e. Slump: 4" maximum

2. Interior Slabs on grade and elevated slabs:

a. Strength: 3,000 psi at 28 days

b. Aggregate: 3/4" minimum, 1 1/2" maximum.

c. W/C Ratio: 0.54 maximum

d. Entrapped Air only (no entrainment), 2.5% +/- 1%

e. Slump: 4" maximum

3. Exterior Slabs and all other exposed Site Concrete not specified elsewhere:

a. Strength: 4,500 psi at 28 days

b. Aggregate: 3/4"

c. W/C Ratio: 0.45 maximum

d. Entrained Air: 6% +/- 1.5%

e. Slump: 4" maximum

4. Add air entraining admixture at manufacturers prescribed rate to result in concrete at point of placement having the above noted air contents.

5. Additional slump may be achieved by the addition of a mid-range or high-range water reducing admixture. Maximum slump after the addition of admixture shall be 6 or 8 inches for mid-range or high range water reducing admixtures, respectively.

D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor, when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Structural Engineer before using in work.

1. Water may be added at the project only if the maximum specified slump and design mix maximum water/cement ratio is not exceeded.

2. Additional dosages of superplastisizer should be used when delays occur and required slump has not been maintained. A maximum of two additional dosages will be permitted per ACI 212.3R recommendations.

2.06 CONCRETE MIXING:

A. Job-Site Mixing will not be permitted.

B. Ready-Mix Concrete: Must comply with the requirements of ASTM C 94, and as herein specified. Provide batch ticket for each batch discharged and used in work, indicating project name, mix type, mix time and quantity.

1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required by Structural Engineer.

2. When the air temperature is between 85 degrees F. and 90 degrees F., reduce the mixing and delivery time from 1 1/2 hours to 75 minutes, and when the air temperature is above 90 degrees F., reduce the mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 FORMS:

A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.

B. Design, construct, erect, maintain, and remove forms for cast-in-place concrete work in compliance with ACI 347.

C. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.

D. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.

E. Vertical dovetail slots may be required for masonry tie installation. Coordinate dovetail slot spacing and location with division 4 specifications and Architectural drawings.

F. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, dovetail slots, reglets, recesses, and the like to prevent swelling and for easy removal.

G. Provide temporary openings where interior area of formwork is inaccessible for clean out, for inspection before concrete placement and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

H. Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

I. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.

    1. Unless otherwise indicated, provide ties for concrete surfaces to be exposed to view in the final condition so portion remaining within concrete after removal is 1" (minimum) inside concrete.

    2. Form ties shall not leave holes larger than 1" diameter in concrete surface. Repair holes left by form ties after removal of formwork.

J. Provision for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

K. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement as required to eliminate mortar leaks and maintain proper alignment.

3.02 PLACING REINFORCEMENT:

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

1. Subgrade tolerance shall conform to a tolerance of +0/-1 1/2". Base tolerance (fine grading) for slabs shall conform to a tolerance of +0"/-3/4" in. Confirm compliance of above tolerances with surveyed measurements taken at 20 ft. intervals in each direction.

2. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

3. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.

4. Place reinforcement to obtain specified coverage for concrete protection within tolerances of ACI-318. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

5. Install welded wire fabric in flat sheets in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.03 JOINTS:

A. Construction Joints: Locate and install construction joints, which are not shown on drawings, so as not to impair strength and appearance of the structure, as acceptable to Architect. Submit plan indicating proposed location of construction joints for review prior to beginning work.

1. Provide keyways at least 1-1/2" deep in construction joints in walls, and slabs; bulkheads reviewed by the Engineer, designed for this purpose may be used for slabs.

2. Roughened surfaces shall be used between walls and footings unless shown otherwise on the drawings. The footing surface shall be roughened to at least an amplitude of 1/4" for the width of the wall before placing the wall concrete.

3. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.

4. Joints in slabs on grade shall be located and detailed as indicated on the drawings. If saw-cut joints are required, the early-entry dry-cut process shall be used. Refer to ACI 302, section 8.3.12.

3.04 INSTALLATION OF EMBEDDED ITEMS:

A. General: Set, securely anchor and build into work prior to concrete placement all anchorage devices and all other embedded items, including but not by limitation reinforcement, reinforcing dowels, embedded plates, anchor rods, anchor inserts, sleeves, load transfer plates, diamond dowels and shelf bulk heads required for other work that is attached to, bear upon, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto. Notify other trades to permit installation of their work. Templates to be utilized for setting of anchorage devices shall be constructed in a manner to allow mechanical consolidation of concrete without disturbance. Embedments shall be placed in a timely fashion to permit the inspection of embedments prior to concrete placement. **"Wet Setting" of embedded items into plastic concrete is strictly prohibited.**

B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface.

C. Provide PVC sleeves where pipes and/or conduit pass through exterior concrete or slabs. Sleeves or penetrations shall not be placed through footings, piers, pedestals, drop caps, columns or pilasters unless specifically noted.

D. Tolerances: Tolerances for Anchor Bolts/Rods, other embedded items and bearing surfaces shall meet the requirement set forth in the latest edition of the American Institute of Steel Construction "Code of Standard Practice for Steel Buildings and Bridges," and ACI 117. The more stringent criteria from these documents shall apply.

3.05 INSTALLATION OF GROUT

A. Place grout for base plates in accordance with manufacturer's recommendations.

B. Grout below setting plates as soon as practicable to facilitate erection of steel and prior to removal of temporary bracing and guys. If leveling bolts or shims are used for erection grout shall be installed prior to addition of any column load.

C. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials and allow to cure. For proprietary grout materials, comply with manufacturer's instructions.

3.06 PREPARATION OF FORM SURFACES:

A. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.

B. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating material manufacturer's directions. Do not allow excess form coating to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

3.07 CONCRETE PLACEMENT:

A. Preplacement Review: Footing bottoms are subject to review by the Geotechnical Engineer. Reinforcement and all concrete preparation work shall be subject to review by the Structural Engineer. Verify that reinforcing, ducts, anchors, seats, plates and other items cast into concrete are placed and securely held. Notify Engineer/Project Special Inspector 48 hours prior to scheduled placement and obtain approval or waiver of review prior to placement. Be sure that all debris and foreign matter is removed from forms.

B. Concrete shall be placed in the presence of an approved testing agency.

C. General: Comply with ACI 304, and as herein specified.

1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing.

2. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients and in a manner which will assure that the required quality of the concrete is maintained.

3. Conveying equipment shall be approved and shall be of a size and design such that detectable setting of concrete shall not occur before adjacent concrete is placed. Conveying equipment shall be cleaned at the end of each operation or work day. Conveying equipment and operations shall conform to the following additional requirements:

a. Belt conveyors shall be horizontal or at a slope which will not cause excessive segregation or loss of ingredients. Concrete shall be protected against undue drying or rise in temperature. An arrangement shall be used at the discharge end to prevent apparent segregation. Mortar shall not be allowed to adhere to the return length of the belt. Long runs shall be discharged into a hopper or through a baffle.

b. Chutes shall be metal or metal-lined and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 feet long, and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.

c. Pumping or pneumatic conveying equipment shall be of suitable kind with adequate pumping capacity. Pneumatic placement shall be controlled so that segregation is not apparent in the discharged concrete.

d. Concrete shall not be conveyed through pipe made of aluminum alloy. Standby equipment shall be provided on the site.

e. Tined rakes are prohibited as a means of conveying fiber reinforced concrete.

4. Do not use reinforcement as bases for runways for concrete conveying equipment or other construction loads.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 18 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment. Hand-spading, rodding or tamping as the sole means for the consolidation of concrete will only be permitted with special permission from the Engineer. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.

2. Use vibrators designed to operate with vibratory equipment submerged in concrete, maintaining a speed of not less than 8000 impulses per minute and of sufficient amplitude to consolidate the concrete effectively. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine, generally at points 18 inches maximum apart. Place vibrators to rapidly penetrate placed layer and at least 6 inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion maintain the duration of vibration for the time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix, generally from 5 to 15 seconds. A spare vibrator shall be kept on the job site during all concrete placing operation.

E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

1. Consolidate concrete using internal vibrators during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations. Do not sprinkle water on plastic surface.

3. Maintain reinforcing in proper position during concrete placement operations.

4. Slab thicknesses indicated on the drawings are minimums. Provide sufficient concrete to account for structure deflection, subgrade fluctuations, and to obtain the specified slab elevation at the flatness and levelness indicated here within.

5. Finish: See “Monolithic Slab Finishes” in this specification for slab finish requirements.

F. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.

1. When air temperature has fallen to or is expected to fall below 40 degrees F (4 degrees C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F (10 degrees C), and not more than 80 degrees F (27degrees C) at point of placement.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators.

4. All temporary heat, form insulation, insulated blankets, coverings, hay or other equipment and materials necessary to protect the concrete work from physical damage caused by frost , freezing action, or low temperature shall be provided prior to start of placing operations.

5. When the air temperature has fallen to or is expected to fall below 40 degrees F, provide adequate means to maintain the temperature in the area where concrete is being placed between 50 and 70 degrees F.

G. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing water.

2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

3. Wet forms thoroughly before placing concrete.

4. Do not use retarding admixtures without the written acceptance by the Architect.

3.08 FINISH OF FORMED SURFACES:

A. Rough Form Finish: For formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This concrete surface shall have texture imparted by form facing material, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4 in. in height rubbed down or chipped off.

B. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, damp-proofing, painting or other similar system. This as-cast concrete surface shall be obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

C. Grout Cleaned Finish: Provide grout cleaned finish to scheduled concrete surfaces which have received smooth form finish treatment. Combine one part Portland cement to 1-1/2 parts fine sand by volume and mix with water to consistency of thick paint. Proprietary additives may be used at Contractor's option. Blend standard Portland cement and white Portland cement, amounts determined by trial patches, so that final color of dry grout will closely match adjacent surfaces.

1. Thoroughly wet concrete surfaces and apply grout to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.

D. Related Unformed Surfaces: At tops of walls and grade beams, horizontal offset surfaces occurring adjacent to formed surfaces, strike-off, smooth and finish with a texture matching adjacent unformed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.09 FLOOR FLATNESS AND LEVELNESS

A. Floor flatness/levelness tolerances: Tolerances for various floor uses shall conform to the requirements set forth in ACI 117 and ACI 302 for “flat” floor profile.

1. Minimum Test Area Flatness/Levelness: F_F35/F_L25

2. Minimum Local F Number: F_F25/F_L15

B. Levelness criteria shall be applied to slabs-on-grade only.

C. Contractor shall measure floor finish within 72 hours after slab finishing and provide corrective measures for finishes not within tolerance. Corrective procedures shall be reviewed by the Architect prior to implementation.

3.10 MONOLITHIC SLAB FINISHES:

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds, and as otherwise indicated.

1. After placing slabs, plane surface to a tolerance not exceeding 1/2 in. in 10 ft. when tested with a 10-ft. straightedge. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, and as otherwise indicated.

C. Trowel Finish: Apply trowel finish to monolithic slab surfaces indicated, including slab surfaces to be covered with carpet, resilient flooring, paint or other thin-film finish coating system.

D. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.

E. Slab finishes for floor coverings not indicated or exposed to view in the final condition shall be coordinated with the Architect prior to slab placement.

F. Slab Joints: Where indicated, sawn slab contraction joints shall be "soft cut", immediately after concrete surface is firm enough not to be torn or damaged by the blade.

3.11 CONCRETE CURING AND PROTECTION:

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 308 as herein specified.

B. Curing Methods: Perform curing of concrete by moist curing, by moisture-retaining cover curing, by curing compound, and by combinations thereof, as herein specified unless noted otherwise. Curing shall commence as soon as concrete surfaces are sufficiently hard as to withstand surface damage. Slabs-on-grade shall be cured by "wet" curing methods unless otherwise noted; Slabs-on-grade to receive floor coverings with moisture sensitive adhesives shall be cured by means of a moisture retaining covering. Coordinate curing with flooring adhesive manufacturer and flooring installer. Submit curing methods to Architect for review and approval.

C. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

D. Protection From Mechanical Injury: During the curing period and duration of construction, the concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration. All finished concrete surfaces shall be protected from damage by construction equipment, materials, or methods, by application of curing procedures, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to overstress the concrete.

3.12 REMOVAL OF FORMS:

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as joints, slabs and other structural elements, may not be removed in fewer than 14 days or until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. Form facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and support.

3.13 REUSE OF FORMS:

A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and latency, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

3.14 MISCELLANEOUS CONCRETE ITEMS:

A. Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

3.15 CONCRETE SURFACE REPAIRS:

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to the Architect.

1. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush coat the area to be patched with approved bonding agent. Place patching mortar after bonding compound has dried.

2. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, form tie holes, cracks, spalls, air bubbles, honeycomb, rock pockets, fins, and other projections on surface and stains and other discolorations that cannot be removed by cleaning.

3.16 QUALITY CONTROL TESTING DURING CONSTRUCTION:

A. Testing Agency/Project Special Inspector shall verify reinforcement, including foundation reinforcement and slab reinforcement (WWF or reinforcing bar). Agent shall verify WWF or reinforcement has been chair/placed with proper clearances.

B. The Owner shall employ a Testing Laboratory to inspect, sample and test the materials and the production of concrete and to submit test reports. Concrete testing shall be performed by technicians certified by the Maine Concrete Technician Certification Board and/or ACI Concrete Field Testing Technician Grade I.

C. Concrete shall be sampled and tested for quality control during placement. Quality control testing shall include the following, unless otherwise directed by the Architect.

D. See Submittals section for report requirements.

E. Sampling Fresh Concrete: ASTM C 172.

1. Slump: ASTM C143; One test for each set of compressive strength test specimens. Sample shall be taken from middle third of the load per ASTM C172. A slump test must be run prior to the incorporation of the CFP fibers per recommendations of ACI 544. A slump test must be run prior to and following the addition of a water reducer (superplasticizer) per recommendations of ACI 301.

2. Air Content: ASTM C231 "Pressure method for normal weight concrete." one test for each set of compressive strength specimens measured at point of discharge.

3. Concrete Temperature: Per ASTM C-1064; one test each time a set of compression test specimens are made.

4. Compression Test Specimen: ASTM C31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.

a. An insulated Cure Box for specimen curing shall be supplied by Testing Agency for initial curing as defined in ACI C31.

b. Means of heating or cooling the Cure Box shall be provided by the Inspection Agency if required in order to maintain a temperature between 60 and 80 degrees F. Contractor shall provide an electrical source to the Testing Agency when required for temperature control.

c. A maximum-minimum thermometer shall be provided in the Cure Box by the Testing Agency to record the temperature range of the Cure Box during specimen curing. The Testing Agency shall record the maximum/minimum temperature of the Cure Box when transferring the specimens to the laboratory.

d. Test Specimens shall be moist cured.

e. Refer to ACI C31 for additional requirements for Test Specimens.

5. Compressive Strength Tests: ASTM C39; one set for each 50 cu. yds. or fraction thereof, of each concrete class placed in any one day or for each 4,000 sq. ft. of surface area placed; 1 specimen tested at 7 days, 2 specimens tested at 28 days, 1 specimen retained in reserve for later testing if required.

6. Pumped concrete shall be tested at point of discharge per ACI 301.

F. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by the Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods, as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

END OF SECTION

SECTION 034500 - PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Architectural precast concrete cladding units.

B. Related Sections include the following:
1. Division 03 Section "Cast-in-Place Concrete" for installing connection anchors in concrete.
2. Division 04 Section "Unit Masonry" for thin brick setting materials and installation after precast concrete panel production.
3. Division 05 Section "Structural Steel Framing" for furnishing and installing connections attached to structural-steel framing.

1.3 DEFINITION

A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Architect.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

1. Loads: As indicated.
2. Wind Loads: See Drawing
3. Seismic Loads: See Drawing.
4. Design framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements as follows:

a. Upward and downward movement of 1/2 inch (13 mm).

5. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 120 deg F (67 deg C).

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.

C. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.

1. Indicate separate face and backup mixture locations and thicknesses.
2. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
3. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
4. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
5. Include plans and elevations showing unit location and sequence of erection for special conditions.
6. Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
7. Indicate relationship of architectural precast concrete units to adjacent materials.
8. Indicate locations and details of brick units, including corner units and special shapes, and joint treatment.
9. Indicate locations and details of stone facings, anchors, and joint widths.
10. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
11. Comprehensive engineering analysis signed and sealed by the qualified professional engineer responsible for its preparation. Show governing panel types, connections, and types of reinforcement, including special reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.

D. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches (300 by 300 by 50 mm).

1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.
2. Samples for each brick unit required, showing full range of color and texture expected. Include Sample showing color and texture of joint treatment.

E. Welding certificates.

F. Qualification Data: For fabricator.

G. Material Test Reports: For aggregates.

H. Material Certificates: For the following items, signed by manufacturers:

1. Cementitious materials.
2. Reinforcing materials and prestressing tendons.
3. Admixtures.
4. Bearing pads.
5. Structural-steel shapes and hollow structural sections.
6. Brick units and accessories.
7. Stone anchors.

I. Source quality-control test reports.

J. Field quality-control test and special inspection reports.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Participates in PCI's plant certification program and is designated a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units.

B. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

C. Design Standards: Comply with ACI 318 (ACI 318M) and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.

D. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

E. Welding: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4, "Structural Welding Code - Reinforcing Steel."

F. Mockups: After sample panel approval but before production of architectural precast concrete units, construct full-sized mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup as indicated on Drawings including sealants and architectural precast concrete complete with anchors, connections, flashings, and joint fillers.
2. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents unless such deviations are specifically approved by Architect in writing.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground.

B. Support units during shipment on nonstaining shock-absorbing material.

C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

D. Place stored units so identification marks are clearly visible, and units can be inspected.

E. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage.

F. Lift and support units only at designated points shown on Shop Drawings.

1.8 SEQUENCING

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

B. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Galvanized Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized.

D. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) ASTM A 706/A 706M, deformed bars, ASTM A 775/A 775M epoxy coated.

E. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, assembled with clips.

F. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from galvanized steel wire into flat sheets.

G. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

H. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain, flat sheet, Type 1 bendable coating.

I. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.

1. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.

B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
2. Metakaolin Admixture: ASTM C 618, Class N.
3. Silica Fume Admixture: ASTM C 1240, with optional chemical and physical requirement.
4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Architect.

D. Lightweight Aggregates: Except as modified by PCI MNL 117, ASTM C 330, with absorption less than 11 percent.

E. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.

F. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

H. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017 M.

2.4 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.

B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

C. Carbon-Steel Plate: ASTM A 283/A 283M.

D. Malleable Iron Castings: ASTM A 47/A 47M.

E. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30 (Grade 415-205).

F. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.

G. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.

H. Wrought Carbon-Steel Bars: ASTM A 675/A 675M, Grade 65 (Grade 450).

I. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.

J. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563 (ASTM A 563M); and flat, unhardened steel washers, ASTM F 844.

K. High-Strength Bolts and Nuts: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563 (ASTM A 563M); and hardened carbon-steel washers, ASTM F 436 (ASTM F 436M).

L. Zinc-Coated Finish: For exterior steel items and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M.

1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

M. Welding Electrodes: Comply with AWS standards.

2.5 BEARING PADS

A. Provide one of the following bearing pads for architectural precast concrete units as recommended by precast fabricator for application:

1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, Type A durometer hardness of 50 to 70, ASTM D 2240, minimum tensile strength 2250 psi (15.5 MPa), ASTM D 412.
2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Type A durometer hardness of 70 to 90, ASTM D 2240; capable of supporting a compressive stress of 3000 psi (20.7 MPa) with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; Type A durometer hardness of 80 to 100, ASTM D 2240; complying with AASHTO's "AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, Division II, Section 18.10.2, or with MIL-C-882E.
4. Frictionless Pads: Tetrafluoroethylene (Teflon), glass-fiber reinforced, bonded to stainless or mild-steel plate, of type required for in-service stress.
5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.6 ACCESSORIES

A. Reglets: Specified in Division 07 Section "Sheet Metal Flashing and Trim."

B. Reglets: PVC extrusions felt or fiber filled, or with face opening of slots covered.

C. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.7 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144, or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.

C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.

2.8 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

1. Limit use of fly ash and silica fume to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.

D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi (34.5 MPa) minimum.
2. Maximum Water-Cementitious Materials Ratio: 0.45.

E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.9 MOLD FABRICATION

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before

reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.

B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Form joints are not permitted on faces exposed to view in the finished work.
2. Edge and Corner Treatment: Uniformly radiused unless otherwise indicated.

2.10 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.

D. Cast-in openings larger than 10 inches (250 mm) in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.

E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
3. Place reinforcement to maintain at least 3/4-inch (19-mm) minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
4. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch (19-mm) minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches (38 mm) when units are exposed to corrosive environment or severe exposure

conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

5. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.

G. Prestress tendons for architectural precast concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 117.

1. Delay detensioning or post-tensioning of precast, prestressed architectural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete.
2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.

H. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch (25 mm) or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.

J. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.

1. Place backup concrete mixture to ensure bond with face-mixture concrete.

K. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.

1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."

L. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.

M. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.

N. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

O. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.11 FABRICATION TOLERANCES

A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

B. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with the following product tolerances:

1. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:

    a. 10 feet (3 m) or under, plus or minus 1/8 inch (3 mm).
    b. 10 to 20 feet (3 to 6 m), plus 1/8 inch (3 mm), minus 3/16 inch (5 mm).
    c. 20 to 40 feet (6 to 12 m), plus or minus 1/4 inch (6 mm).
    d. Each additional 10 feet (3 m), plus or minus 1/16 inch (1.5 mm).

2. Overall Height and Width of Units, Measured at the Face Not Exposed to View: As follows:

    a. 10 feet (3 m) or under, plus or minus 1/4 inch (6 mm).
    b. 10 to 20 feet (3 to 6 m), plus 1/4 inch (6 mm), minus 3/8 inch (10 mm).
    c. 20 to 40 feet (6 to 12 m), plus or minus 3/8 inch (10 mm).
    d. Each additional 10 feet (3 m), plus or minus 1/8 inch (3 mm).

3. Total Thickness or Flange Thickness: Plus 1/4 inch (6 mm), minus 1/8 inch (3 mm).
4. Rib Thickness: Plus or minus 1/8 inch (3 mm).
5. Rib to Edge of Flange: Plus or minus 1/8 inch (3 mm).
6. Distance between Ribs: Plus or minus 1/8 inch (3 mm).
7. Variation from Square or Designated Skew (Difference in Length of the Two Diagonal Measurements): Plus or minus 1/8 inch per 72 inches (3 mm per 1830 mm) or 1/2 inch (13 mm) total, whichever is greater.
8. Length and Width of Block-outs and Openings within One Unit: Plus or minus 1/4 inch (6 mm).
9. Location and Dimension of Block-outs Hidden from View and Used for HVAC and Utility Penetrations: Plus or minus 3/4 inch (19 mm).
10. Dimensions of Haunches: Plus or minus 1/4 inch (6 mm).
11. Haunch Bearing Surface Deviation from Specified Plane: Plus or minus 1/8 inch (3 mm).
12. Difference in Relative Position of Adjacent Haunch Bearing Surfaces from Specified Relative Position: Plus or minus 1/4 inch (6 mm).
13. Bowing: Plus or minus L/360, maximum 1 inch (25 mm).

14. Local Smoothness: 1/4 inch per 10 feet (6 mm per 3 m).
15. Warping: 1/16 inch per 12 inches (1.5 mm per 300 mm) of distance from nearest adjacent corner.
16. Tipping and Flushness of Plates: Plus or minus 1/4 inch (6 mm).
17. Dimensions of Architectural Features and Rustications: Plus or minus 1/8 inch (3 mm).

C. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.

1. Weld Plates: Plus or minus 1 inch (25 mm).
2. Inserts: Plus or minus 1/2 inch (13 mm).
3. Handling Devices: Plus or minus 3 inches (75 mm).
4. Reinforcing Steel and Welded Wire Fabric: Plus or minus 1/4 inch (6 mm) where position has structural implications or affects concrete cover; otherwise, plus or minus 1/2 inch (13 mm).
5. Reinforcing Steel Extending out of Member: Plus or minus 1/2 inch (13 mm) of plan dimensions.
6. Tendons: Plus or minus 1/4 inch (6 mm), vertical; plus or minus 1 inch (25 mm), horizontal.
7. Location of Rustication Joints: Plus or minus 1/8 inch (3 mm).
8. Location of Opening within Panel: Plus or minus 1/4 inch (6 mm).
9. Location of Flashing Reglets: Plus or minus 1/4 inch (6 mm).
10. Location of Flashing Reglets at Edge of Panel: Plus or minus 1/8 inch (3 mm).
11. Reglets for Glazing Gaskets: Plus or minus 1/8 inch (3 mm).
12. Electrical Outlets, Hose Bibs: Plus or minus 1/2 inch (13 mm).
13. Location of Bearing Surface from End of Member: Plus or minus 1/4 inch (6 mm).
14. Allowable Rotation of Plate, Channel Inserts, and Electrical Boxes: 2-degree rotation or 1/4 inch (6 mm) maximum over the full dimension of unit.
15. Position of Sleeve: Plus or minus 1/2 inch (13 mm).
16. Location of Window Washer Track or Buttons: Plus or minus 1/8 inch (3 mm).

2.12 FINISHES

A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved design reference sample and as follows:
1. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated.
2. As-Cast Surface Finish: Provide surfaces free of pockets, sand streaks, and honeycombs.

B. Finish exposed top bottom and back surfaces of architectural precast concrete units to match face-surface finish.

C. Finish unexposed surfaces of architectural precast concrete units by float finish.

D. Color: Dark gray to match siding.

2.13 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."

B. Owner will employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.

1. Allow Owner's testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.

C. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 (ACI 318M) requirements for concrete strength.

D. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 (ACI 318M) requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.

1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
2. Cores will be tested in an air-dry condition.
3. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
4. Test results will be made in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:

a. Project identification name and number.
b. Date when tests were performed.
c. Name of precast concrete fabricator.
d. Name of concrete testing agency.
e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

E. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Do not install precast concrete units until supporting cast-in-place building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is complete.

3.2 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.

1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
4. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch (19 mm).

C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

1. Do not permit connections to disrupt continuity of roof flashing.

D. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
2. Welds not specified shall be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil- (0.1-mm-) thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
4. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.

5. Remove, reweld, or repair incomplete and defective welds.

E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.

F. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

3.3 ERECTION TOLERANCES

A. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

B. Erect architectural precast concrete units level, plumb, square, and true, without exceeding the following noncumulative erection tolerances:

1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch (13 mm).
2. Plan Location from Centerline of Steel: Plus or minus 1/2 inch (13 mm).
3. Top Elevation from Nominal Top Elevation: As follows:

    a. Exposed Individual Panel: Plus or minus 1/4 inch (6 mm).
    b. Non-Exposed Individual Panel: Plus or minus 1/2 inch (13 mm).
    c. Exposed Panel Relative to Adjacent Panel: 1/4 inch (6 mm).
    d. Non-Exposed Panel Relative to Adjacent Panel: 1/2 inch (13 mm).

4. Support Elevation from Nominal Support Elevation: As follows:

    a. Maximum Low: 1/2 inch (13 mm).
    b. Maximum High: 1/4 inch (6 mm).

5. Maximum Plumb Variation over the Lesser of Height of Structure or 100 Feet (30 m): 1 inch (25 mm).
6. Plumb in Any 10 Feet (3 m) of Element Height: 1/4 inch (6 mm).
7. Maximum Jog in Alignment of Matching Edges: 1/4 inch (6 mm).
8. Joint Width (Governs over Joint Taper): Plus or minus 1/4 inch (6 mm).
9. Maximum Joint Taper: 3/8 inch (10 mm).
10. Joint Taper in 10 Feet (3 m): 1/4 inch (6 mm).
11. Maximum Jog in Alignment of Matching Faces: 1/4 inch (6 mm).
12. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 1/4 inch (6 mm).
13. Opening Height between Spandrels: Plus or minus 1/4 inch (6 mm).

C. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

D. Field welds will be subject to visual inspections and nondestructive testing according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.

E. Testing agency will report test results promptly and in writing to Contractor and Architect.

F. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 REPAIRS

A. Repair architectural precast concrete units if permitted by Architect. The Architect reserves the right to reject repaired units that do not comply with requirements.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).

C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.5 CLEANING

A. Clean surfaces of precast concrete units exposed to view.

B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034500

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:

1. Concrete masonry units (CMUs).
2. Face brick.
3. Building (common) brick.

B. See Division 05 Section "Metal Fabrications" for furnishing steel lintels for unit masonry.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For reinforcing steel. Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement.

C. Samples for each type and color of exposed masonry units and colored mortars.

D. Material Certificates: For each type of product indicated. Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards.

1. For masonry units include material test reports substantiating compliance with requirements.

E. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.

1.3 QUALITY ASSURANCE

A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner.

1. Clay Masonry Unit Test: For each type of unit required, per ASTM C 67.
2. Concrete Masonry Unit Test: For each type of unit required, per ASTM C 140.
3. Mortar Test (Property Specification): For each mix required, per ASTM C 780 .
4. Grout Test (Compressive Strength): For each mix required, per ASTM C 1019.

B. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and

inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

C. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects.

1. Build sample panels for typical exterior wall including in sizes approximately 48 inches (1200 mm) long.

1.4 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 COLORS, TEXTURES, AND PATTERNS

A. Exposed Masonry Units: As selected from manufacturer's full range.

2.3 CONCRETE MASONRY UNITS (CMUs)

A. Shapes: Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. Concrete Masonry Units: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 MPa) unless stated otherwise in Drawings.
2. Provide CMU as indicated on the drawings for the stair and elevator shafts

3. The brick ties are HB X-seal http://www.h-b.com/products/view/details/X-SEAL or architect approved equal.

2.4 CONCRETE AND MASONRY LINTELS

A. General: Provide either concrete or masonry lintels, at Contractor's option, complying with requirements below.

B. Masonry Lintels: Made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout.

2.5 BRICK

General: Provide shapes indicated and as follows: Old Port Blend with narrow flashing or approved equal brick

There are special brick shapes – see drawings.

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: ASTM C 216, Grade SW.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi (20.7 MPa).
2. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67.
3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
4. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet (3 m).
5. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long.
6. Bricks with frogs are not allowed.
7. Provide shaped bricks as indicated on drawings.
8. Type: Old Port Blend with narrow flashing or architect approved equal.

2.6 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.

B. Hydrated Lime: ASTM C 207, Type S.

C. Masonry Cement: ASTM C 91.

1. Available Products:

    a. Capital Materials Corporation; Flamingo Color Masonry Cement.
    b. Essroc, Italcementi Group; Brixment or Velvet.
    c. Lafarge North America Inc.; Magnolia Masonry Cement Lafarge Masonry Cement Trinity White Masonry Type N.
    d. Lehigh Cement Company; Lehigh Masonry Cement Lehigh White Masonry Cement.
    e. National Cement Company, Inc.; Coosa Masonry Cement.

D. Mortar Pigments: Iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Available Products:

    a. Bayer Corporation, Industrial Chemicals Div.; Bayferrox Iron Oxide Pigments.
    b. Davis Colors; True Tone Mortar Colors.
    c. Solomon Grind-Chem Services, Inc.; SGS Mortar Colors.

E. Aggregate for Mortar: ASTM C 144.

1. For joints less than 1/4 inch (6.5 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

F. Aggregate for Grout: ASTM C 404.

G. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Available Products:

    a. Addiment Incorporated; Mortar Kick.
    b. Euclid Chemical Company (The); Accelguard 80.
    c. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset.
    d. Sonneborn, Div. of ChemRex; Trimix-NCA.

I. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Masonry Joint Reinforcement: ASTM A 951; mill galvanized, carbon-steel wire for interior walls and hot-dip galvanized, carbon-steel wire for exterior walls.

1. Wire Size for Side Rods: W2.8 or 0.188-inch (4.8-mm) diameter.
2. Wire Size for Cross Rods: W2.8 or 0.188-inch (4.8-mm) diameter.
3. Wire Size for Veneer Ties: W2.8 or 0.188-inch (4.8-mm) diameter.
4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
5. Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.
6. Multiwythe Masonry:

   a. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches (100 mm) in width, plus 1 side rod at each wythe of masonry 4 inches (100 mm) or less in width.

7. Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.188-inch- (4.8-mm) diameter, hot-dip galvanized, carbon-steel continuous wire.

2.8 TIES AND ANCHORS

A. Materials:

1. Stainless steel Wire: ASTM A 82; with ASTM A 153/A 153M.
2. Steel Sheet, stainless: ASTM A 1008/A 1008M, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to face of veneer.

   1) Individual Wire Ties: The Brick ties are HB X-Seal Anchor System by Hohmann & Barnard, Inc. or architectural approved equal.

2.9 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing**,** where flashing is exposed or partly exposed and where indicated, complying with Division 07 Section "Sheet Metal Flashing and Trim."

1. Metal Drip Edges: HB Flashing DP-Drip Plate or architect approved equal Fabricate from stainless steel. Extend at least 3 inches (75 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees.

B. Flexible Flashing: For flashing not exposed to the exterior, use the following, unless otherwise indicated:

   a. Henry Blueskin TWF or architect approved equal.
      1) 40 mils
      2) Tensile Strength (Membrane): 800 psi minimum.

2. Rubberized-Asphalt Flashing: Not allowed.

3. EPDM Flashing: Not allowed.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer.

2.10 CONCEALED FLASHING

A. Concealed Flashing: For flashing partly exposed to the exterior, use metal flashing specified above. For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:
1. Copper-Laminated Flashing: Manufacturer's standard laminated flashing consisting of 7-oz./sq.ft. (2-kg/sq.m) sheet copper bonded with asphalt between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
a. Provide flashing as a complete system with preformed corners, end dams, other special shapes, and seaming materials; all produced by flashing sheet manufacturer.

2.11 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene or urethane.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use the following, unless otherwise indicated:
1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.

a. Available Products:

1) Advanced Building Products Inc.; Mortar Maze weep vent.
2) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
3) Heckmann Building Products Inc.; No. 85 Cell Vent.
4) Hohmann & Barnard, Inc.; Quadro-Vent.
5) Wire-Bond; Cell Vent.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Provide one of the following configurations:

a. Strips, full-depth of cavity and 10 inches (250 mm) wide, with dovetail shaped notches 7 inches (175 mm) deep.

b. Strips, not less than 1-1/2 inches (38 mm) thick and 10 inches (250 mm) wide, with dimpled surface designed to catch mortar droppings and prevent weep holes from being clogged with mortar.
c. Sheets or strips full depth of cavity and installed to full height of cavity.

2. Available Products:

a. Advanced Building Products Inc.; Mortar Break.
b. Archovations, Inc.; CavClear Masonry Mat.
c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
d. Mortar Net USA, Ltd.; Mortar Net.

2.12 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains from new masonry without damaging masonry. Use product approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Available Manufacturers:

a. Diedrich Technologies, Inc.
b. EaCo Chem, Inc.
c. ProSoCo, Inc.

2.13 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement and lime.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification.

C. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement by weight.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is required, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

D. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:

1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.

3.2 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

D. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.

E. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

3.3 MORTAR BEDDING AND JOINTING

A. Lay hollow concrete masonry units as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.

2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
1. Maintain joint thicknesses indicated except for minor variations required to maintain bond alignment. If not indicated, lay walls with 1/4- to 3/8-inch- (6- to 10-mm-) thick joints.
2. Where epoxy-mortar pointed joints are indicated, rake out setting mortar to a uniform depth of 1/4 inch (6 mm) and point with epoxy mortar.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.4 COMPOSITE MASONRY

A. Bond wythes of composite masonry together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. (0.42 sq. m) of wall area spaced not to exceed 24 inches (610 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (915 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.

    a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.

B. Collar Joints: Solidly fill collar joints by parging face of first wythe that is laid and shoving units of other wythe into place.

C. Corners: Provide interlocking masonry unit bond in each wythe and course at corners, unless otherwise indicated.

D. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:

1. Provide individual metal ties not more than 16 inches (406 mm) o.c.
2. Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units.

3. Provide rigid metal anchors not more than 24 inches (610 mm) o.c. If used with hollow masonry units, embed ends in mortar-filled cores.

3.5 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. (0.42 sq. m) of wall area spaced not to exceed 24 inches (610 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (915 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.

    a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
    b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.

3. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Parge cavity face of backup wythe in a single coat approximately 3/8 inch (10 mm) thick. Trowel face of parge coat smooth.

D. Coat cavity face of backup wythe to comply with Division 07 Section "Bituminous Dampproofing."

E. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches (300 mm) o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit insulation between wall ties and other confining obstructions, with edges butted tightly. Press units firmly against inside wythe of masonry.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 1/2 inch (13 mm) in width between masonry and structural member, unless otherwise indicated.
2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.8 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through sheathing and insulation to wall framing with metal fasteners of type indicated. Use two fasteners.
2. Embed connector sections and continuous wire in masonry joints. Provide not less than 2 inches (50 mm) of air space between back of masonry veneer and face of sheathing.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally with not less than 1 anchor for each 3.5 sq. ft. (0.33 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm), around perimeter.

3.9 EXTERIOR TILE AND MORTOR

A. Install per manufacturer's recommendations.

3.10 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows, unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing as recommended by flashing manufacturer.
2. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.

3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.

C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.
2. Space weep holes 24 inches (600 mm) o.c., unless otherwise indicated.
3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.

D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.

3.11 FIELD QUALITY CONTROL

A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.

1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.

B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:

1. Payment for these services will be made by Owner.

C. Testing Frequency: One set of tests for each 5000 sq. ft. (465 sq. m) of wall area or portion thereof.

D. Clay Masonry Unit Test: For each type of unit provided, per ASTM C 67.

E. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.

F. Mortar Test (Property Specification): For each mix provided, per ASTM C 780 . Test mortar for mortar air content.

G. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.

3.12 CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Protect adjacent surfaces from contact with cleaner.
3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.13 MASONRY WASTE DISPOSAL

A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.
2. Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 04 23 00 - REINFORCED UNIT MASONRY

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Related Documents: The general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work specified in this section.

B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK:

A. Reinforced masonry work includes all labor, materials, and equipment necessary and required for reinforced concrete masonry.

B. Extent of work to be performed and/or coordinated shown on the drawings and indicated in the specifications including, but not limited to masonry units, reinforcing, accessories, and grout.

C. Coordinate work with all other trades, including but not limited to concrete reinforcement and structural steel.

1.03 RELATED WORK

A. Cast-in-Place Concrete: Section 03 30 00

B. Expansion/Adhesive Anchors: Section 05 12 00

C. Embedded Items: Section 05 50 00

1.04 QUALITY ASSURANCE:

A. Codes and Standards: Comply with provisions of the latest edition of the following except where more stringent requirements are shown or specified:

1. ACI 530 “Building Code Requirements for Masonry Structures”.

2. ACI 530.1 “Specification for Masonry Structures”.

3. ACI “Detailing Manual for Reinforced Concrete” (SP-66).

4. CRSI “Manual of Standard Practice”

5. CRSI "Placing Reinforcing Bars"

6. "Code of Federal Regulations, Part 1926" per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).

B. Fire Performance Characteristics: Where indicated, provide materials and construction identical to those of assemblies whose fire resistance has been determined by ASTM E119, by a testing and inspecting organization, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

C. Materials and installed work may require testing and retesting, as directed by the Architect, at any time during progress of work. Allow free access to material stockpiles and facilities. Tests not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.

1.05 SUBMITTALS:

A. Unless otherwise specified, submittals required in this section shall be submitted for review.

B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner's Notice to Proceed.

C. All submittals shall be reviewed and returned to the Architect within 10 working days.

D. Incomplete submittals will not be reviewed.

E. Submittals not reviewed by the General Contractor prior to submission to the Engineer will not be reviewed. Include on the submittal statement or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Section 01000 have been complied with.

F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.

G. Product Data: Submit producer's or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

1. Reinforcement certified mill reports covering chemical and physical properties and yield strength.

2. Masonry sizes, shapes, weights, densities, strengths, material composition, admixtures, colors, and manufacturing processes and procedures.

3. Mortar and/or Grout.

4. Accessories, Ties, and Joint Reinforcement

5. Admixtures.

6. Expansion/Adhesive Anchors.

H. Shop Drawings:

1. Shop Drawing Review: Electronic files of structural drawings will not be provided to the contractor for preparation of shop drawings. Submit shop drawings for fabrication, bending and placement of masonry reinforcement. Comply with ACI 315, showing bar schedules, stirrup and tie spacing, diagrams of bent bars, and arrangement of masonry reinforcement. Include special reinforcement required at openings through masonry. Include supplemental reinforcing and bar supports necessary to support reinforcing steel at proper location within masonry units and bond beams. Coordinate masonry reinforcement with concrete reinforcement.

2. Review of the shop drawings will be made for the size and arrangement of reinforcement. Conformance of the Shop Drawings to the Contract Drawings remains the responsibility of the General Contractor. Engineer's review in no way relieves the General Contractor of this responsibility. Submit one print and one reproducible. Print will be reviewed and a reproducible will be returned to Contractor for printing and distribution. Multiple copies will not be marked by Engineer.

3. Shop drawings will not be reviewed as partial submittals. A complete submittal shall be provided all items listed prior. Incomplete submittals will not be reviewed.

4. Mix designs: Submit all laboratory test reports and materials for each mix design listed within. Prepare mixes by the field experience method and/or trial mixtures per the requirements of chapter 5 of ACI 318. Proportioning by water cement ratio method will not be permitted.

5. Samples: Submit samples of materials as specified and as otherwise requested by Architect, including names, sources and descriptions.

6. Contraction/Construction Joints: Submit plan indicating proposed location of contraction and construction joints in masonry walls.

PART 2 - PRODUCTS

2.01 MASONRY MATERIALS

A. Load Bearing Units:

1. Hollow Load Bearing Units: ASTM C-90

a. Normal weight units

b. Minimum average net area compressive strength = 1,900 psi.

2. Solid Load Bearing Units: ASTM C-145

a. Normal weights units

b. Minimum average net area compressive strength = 1,900 psi

3. Nominal Dimensions:

a. 12" units: 15-5/8"x11-5/8"x7-5/8" actual

b. 8" units: 15-5/8x7-5/8"x7-5/8" actual

c. Provide other nominal sizes as indicated on the Architectural Drawings or in related specifications.

d. Construct lintels using reinforced concrete masonry units with grouted joints where shown. Lintels may be prefabricated for incorporation into work.

4. Single Source for Masonry Units: Obtain masonry units of uniform texture and color as specified from single manufacturer.

B. Fire Rating Requirements: Concrete masonry units shall have a U.L. listed fire rating of as indicated on the Architectural Drawings or in related specifications.

2.02 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I, except Type III may be used for cold weather construction. Provide natural color unless otherwise indicated.

B. Ready-Mixed Mortar: Cementitious materials, water, and aggregate complying with requirements specified here within, combined with set-controlling admixtures to produce ready-mixed mortar complying with ASTM C1142.

C. Aggregate for Mortar: ASTM C144, except for joints less than 1/4" thick, use aggregate graded with 100 percent passing No. 16 Sieve.

D. Aggregate for Grout: ASTM C 404.

E. Water: Clean and potable

F. Additives: None permitted.

2.03 MORTAR AND GROUT MIXES:

A. General: Do not add admixtures including coloring pigments, air-entraining agents, accelerators, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

B. Mortar:

1. Job mixed mortar: Comply with ASTM C270, Proportion Specification for job mixed mortar
2. Ready-mixed mortar: ASTM C 1142
3. Masonry cement shall consist of portland-cement lime; mortar cement is acceptable, masonry cement is not acceptable.
4. Mortar shall be Type S, unless otherwise noted.
5. Mortar compressive stress when tested per ASTM C270 at 28-days shall be a minimum of 1,800 psi.
6. Single Source for Mortar Units: Obtain mortar materials of uniform texture and color as specified from single manufacturer.

C. Grout:

1. Comply with ASTM C476.

2.04 MASONRY REINFORCEMENT:

A. General: Comply with this specification for placing reinforcement. Comply with Division 3, Section 03300 for other requirements. Shop fabricate, whenever possible, reinforcing bars shown as bent or hooked.

B. Deformed Bars: Provide ASTM A615 Grade 60 deformed bars. Except provide ASTM A615 Grade 60s where field bending of reinforcement is required or intended, and ASTM A-706 Grade 60 for all conditions where welding of reinforcement is required.

C. Smooth Steel Wire: Provide ASTM A675 Grade 80 for all #2 bars of smooth, round stock, where noted on the drawings for use in columns or pilasters as ties.

2.05 MASONRY ACCESSORIES:

Q. General: Provide accessories and other items as required herein and in related specification sections and as indicated on the drawings. For all types of accessories, hot-dip galvanize after fabrication with 1.5 oz. zinc coating, ASTM A-153, Class B2.

R. Prefabricated Joint Reinforcing: Provide continuous welded wire units prefabricated in straight lengths of not less than 10', with matching corner and tee units. Fabricate from cold-drawn steel wire complying with ASTM A-82, deformed continuous side rods with 3/16" diameter and plain 9 gage cross-rods, unit width of 1-1/2" less than thickness of wall/partition. Subject to compliance,

provide products manufactured by "Dur-O-Wal", "AA Wire Products Company", or approved equal.

a. Single Width Walls: Truss type fabricated with single pair 3/16 gauge side rods and 9 gage continuous diagonal cross-rods.

S. Reinforcing Bar Positioners: Provide reinforcing bar supports/positioners for accurate positioning of horizontal and vertical reinforcement in walls, bond beams, and lintels. Fabricate from cold-drawn plain 9 gage steel wire complying with ASTM A-82. Subject to compliance, provide products manufactured by "Dur-O-Wal", "AA Wire Products Company", or approved equal.

D. Masonry Anchors and Ties: Provide straps, bars, bolts, rods, dovetail slots, metal fasteners indicated and other required accessory items of type, size, spacing, and at locations as required in related specification sections as identified on the drawings. Where masonry is indicated to be anchored to structural framework with flexible anchors, provide 2-piece anchors which will permit horizontal and vertical movement but will provide lateral restraint out of plane of wall.

E. Related Masonry Items: Provide joint fillers, insulation, flashings, weepholes, and other items related to masonry work as required in related specification sections and as identified on the drawings.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. General: Build masonry construction as required in related specification sections and as identified on the drawings. Build masonry construction to full thickness shown, except, single-wythe walls to actual thickness of masonry units, using units of nominal thickness shown or specified.

B. Do not use frozen materials or materials mixed/coated with ice or frost. Do not build on frozen work. Remove and replace masonry work damaged by frost or freezing. Do not wet concrete masonry units (CMU).

C. Mortar: Provide full mortar coverage on all horizontal and vertical surfaces including face shells and webs.

D. Reinforced Concrete Masonry Unit Walls: Lay CMU wall units in running bond with vertical joints in each course centered on units above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special shaped units where shown, and/or as required for corners, jambs, sash, control joints, lintels, bond beams, and other special conditions.

1. Maintain vertical continuity of core or cell cavities which are to be reinforced and grouted Keep cavities free of mortar. Solidly bed webs of masonry with mortar where adjacent to cells to be grouted.

2. Use special units or modify standard units, where horizontal reinforcing is shown to provide for continuous placement of reinforcing and grout. Place small mesh expanded

metal lath or wire screening in joints under bond beam courses above cells of non-reinforced or non-grouted masonry elements or provide bond beam units with solid bottoms (lintel block units). Provide open end bond beam units where horizontal and vertical reinforcing pass through same units.

3.02 PLACING REINFORCEMENT:

A. General: Clean reinforcement of loose rust, mill scale, earth, ice, or other materials which will reduce bond to mortar or grout. Do not use reinforcement with kinks or bends not shown on drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes. Position reinforcement accurately at spacing shown on contract drawings.

B. Vertical Reinforcing: Support and secure vertical reinforcing against displacement. Vertical reinforcing shall be held in position at the top and bottom and at intervals not exceeding 192 bar diameters nor 10'-0" with a minimum clearance of ¼" from the face of the masonry and not less than one bar diameter or 1", whichever is greater, between adjacent bars.

1. For columns, piers, and pilasters, provide a clear distance between vertical bars as indicated, but not less than 1-1/2 times the nominal bar diameter or 1-1/2", whichever is greater. Provide lateral ties as indicated in the details.

2. All dowels shall be grouted even if the dowel is in a cell adjacent to the vertical reinforcing. Unless detailed otherwise on the drawings, dowels shall be the same size, number, and spacing as the vertical reinforcing. Provide lap length of dowels to vertical reinforcing equal to forty-eight (48) times nominal diameter of dowel, unless indicated otherwise on the drawings. Dowels for columns and pilasters shall be installed using steel or wood templates to accurately position dowels as indicated on the drawings.

C. Horizontal Reinforcing: Support and secure horizontal reinforcing against displacement. Horizontal reinforcing shall be held in position at intervals not exceeding 100 bar diameters with a minimum clearance of ¼" from the face of the masonry and not less than one bar diameter or 1", whichever is greater, between adjacent bars. Provide laps or dowels around corners and across intersections as indicated on the drawings.

1. Horizontal reinforcing shall be placed in continuous bond beam or lintel block units and shall be solidly grouted in place. Horizontal reinforcement shall be CONTINUOUS THROUGH CONTROL JOINTS, but shall be DISCONTINOUS AT EXPANSION JOINTS. Horizontal reinforcement may be placed as masonry work progresses.

D. Splices: Splice reinforcement where shown or indicated on the drawings. Do not splice at other locations unless acceptable to the Structural Engineer. Minimum lap splice length shall be 48 bar diameters, of the smaller bar diameter, unless indicated otherwise on the drawings. Stagger adjacent splices at least one full lap length so that no more than 25% of the number of bars are spliced at any one location. Where splicing at vertical bars or at dowels, provide full contact, lap ends of bars, and wire tie.

E. Reinforcing Bar Positioners: Provide where required and at required spacing to support and secure horizontal and vertical reinforcing against displacement and to accurately align and position splices

in reinforcement.

F. Prefabricated Joint Reinforcing: Provide continuous horizontal joint reinforcing as shown/specified. Fully embed longitudinal side rods in mortar for entire length with minimum cover of 5/8" on exterior side of walls and ½" at other locations. Lap reinforcement a minimum of 6" at ends of units. Do not bridge control/expansion joints with joint reinforcing. Provide continuity at corners/wall intersections by the use of prefabricated "L" and "T" sections. Cut/bend units as directed by manufacturer for continuity at returns/offsets/column fireproofing, pipe enclosures, and/or special conditions. Space continuous horizontal reinforcing as follows:

1. For single-wythe walls, space 16" o.c. vertically, unless indicated.

G. Metal Ties: Where indicate, install in mortar joints as work progresses, with a minimum mortar cover of at least 5/8" on exterior faces and ½" on interior faces of masonry work.

H. Anchors: Install anchors for reinforced masonry elements to supporting structure as indicated on the drawings or required in the specifications.

3.03 FORMWORK AND SHORING:

A. General: Provide temporary formwork and/or shoring as required for temporary support of reinforced masonry work. Refer to Division 3, Section 03300 for additional requirements.

B. Removal: Formwork and/or shoring shall not be removed until the reinforced masonry element has cured sufficiently to carry its own weight and any other loads that may be placed on it during construction. It is the contractor's sole responsibility to determine formwork and shoring requirements and durations. In no case shall formwork or shores be removed before the following periods:

1.	Lintels and beams:	10 days
2.	Masonry soffits:	7 days
3.	Columns and pilasters:	7 days

3.04 GROUTING

A. General: Grout mix and grout materials shall conform to ASTM C 476. Refer to Division 3, Section 033000, "Cast-In-Place Concrete" for requirements.

1. Use "Fine Grout" for filling spaces less than 2" in either horizontal dimension. Where shown solid, use mortar for cavities less than ¾" in width or spaces less than 1-1/2" x 2" in horizontal dimensions.

2. Use “Coarse Grout” for filling cavities 2” or larger in width or cells 2”x3” or larger in horizontal dimensions.

3. Use “Concrete”, 3000 psi normal weight, for filling spaces ten (10) inches or larger in both horizontal dimensions.

B. Preparation: Prior to grouting, inspect and clean grout spaces. Remove dust, dirt, mortar droppings, loose pieces of masonry, and other foreign materials. Clean and position reinforcing. Clean top surface of structural members to ensure bond. After final cleaning and inspection, close and brace clean out holes.

1. Do not grout until entire height of masonry to be grouted has attained sufficient strength to resist forces and pressures of grouting operation. Install shores and braces, if required, before beginning grouting.

C. Grouting Method: Grouting shall conform to low-lift or high-lift grouting, at Contractor’s option, subject to following requirements.

1. Low-Lift Grouting:

a. Low-Lift Grouting SHALL NOT exceed a pour of more than five (5) feet in height not the “Maximum Grout Pour Height” identified below.

b. Provide minimum clear dimension of two (2) inches and minimum clear area of eight (8) sq. inches in vertical cavities, cells, or cores to be grouted.

c. Place vertical reinforcement prior to laying of masonry units. Extend above elevation of maximum pour height as required to allow for splicing. Support and secure reinforcing as masonry is built.

d. Lay masonry to maximum pour height. Do not exceed five feet (5 ft.) or if bond beam occurs below five feet (5 ft.) height, stop pour or course below bond beam.

2. High-Lift Grouting:

a. High-Lift Grouting SHALL NOT exceed a pour of one story, but in no case more than twenty-four (24) feet in height nor the “Maximum Grout Pour Height” identified below.

b. High-Lift Grouting is NOT PERMITTED unless minimum cavity dimension exceeds three (3) inches and minimum cavity area exceeds ten (10) sq. inches.

c. Cleanout holes ARE REQUIRED where high-lift grouting will be employed. Provide cleanouts at the bottom course of masonry at each cell to be grouted for each pour. For solid grouted masonry space cleanouts at 32 in. o.c.

d. Cleanout holes shall have minimum width of 3 inches and a minimum height of 6 inches. After cleaning, close cleanouts and brace closures to resist hydrostatic grout pressure.

e. Prior to grouting, construct masonry elements and place and secure reinforcing to full height of maximum grout pour. Place horizontal bond beam reinforcing as masonry units are laid.

f. Where lateral tie reinforcing is shown, embed in mortar joints at vertical spacing indicated as units are laid. Where lateral ties wrap vertical reinforcing, embed additional lateral tie reinforcing in mortar joints to resist hydrostatic rupture of masonry face shells. Provide not less than No. 2 bars or 8 gage wire ties spaced at 16 in. o.c. for members with side dimensions of 20 in. or less and at 8 in. o.c. where side dimensions exceed 20 in.

D. Maximum Grout Pour Height: In no case shall total grout pour height exceed the following heights regardless of grouting method used.

Grout Type	Max. Height	Min. Cavity	Min. Cell
Fine	1'-0"	¾"	1-1/2" x 2"
Fine	5'-0"	2"	2" x 3"
Fine	12'-0"	2-1/2"	2-1/2" x 3"
Fine	24'-0"	3"	3" x 3"
Coarse	1'-0"	2"	2" x 3"
Coarse	5'-0"	2"	2-1/2" x 3"
Coarse	12'-0"	2-1/2"	3" x 3"
Coarse	24'-0"	3"	3" x 4"

Min. Cavity applies to grouting between wythes of cavity walls. Min. Cell applies to grouting of masonry cells where dimension shown equals grout space width minus horizontal reinforcing bar diameter.

E. Grout Placement: Limit grout pours to sections which can be completed in one working day with not more than one (1) hour of interruption of pouring operation. Allow not less than thirty (30) minutes, nor more than one (1) hour between lifts of given pour. Rod or vibrate each lift during pouring operation.

1. Place grout in lifts not to exceed a maximum height of five (5) feet each, regardless of the maximum height of the pour.

2. Place grout in lintels and beams over openings in one continuous pour.

3. Pour grout using chute or container with spout. Terminate pour 1-1/2" below top course to form key for next pour.

4. Where bond beams occur, terminate grouting of vertical cells 1-1/2" below bond beam

course. After placing horizontal reinforcing and prior to filling vertical cells above bond beam, pour grout into bond beam and strike off flush with top of bond beam course.

F. Lintels: Install loose lintels of steel and other materials where shown. Provide masonry lintels where shown and wherever openings of more than 1'-0" are shown without structural steel or other supporting lintels. Provide formed-in-place masonry lintels. Provide minimum bearing at each jamb, of 4" at openings less than 4'-0" wide and 8' for wider openings.

G. Other Items: Provide vertical expansion, control and isolation joints, and provide concealed flashing and weep holes in masonry where shown. Build-in related masonry accessory items as the masonry work progresses. Refer to Section 04200, "Unit Masonry" and related specifications sections and to drawings.

1. Comply with requirements for repair, pointing and cleaning in accordance with Section 04200, "Unit Masonry".

H. Construction Tolerances: Variations in reinforced masonry work from plumb and level, locations of built-in or embedded items, and other required tolerances shall be as required in related specification sections or as identified on the drawings.

I. Protection of Work: Do not apply uniform loading for at least 12 hours after building masonry walls or columns. Do not apply concentrated loads for at least 3 days after building masonry walls, lintels, beams, columns, pilasters, and piers.

J. Responsibility for Errors: Contractor shall bear all costs associated with corrective work resulting from errors or poor workmanship, including costs of architectural and engineering services associated with required correction.

3.05 QUALITY CONTROL TESTING DURING CONSTRUCTION:

A. Testing Agency/Project Special Inspector shall verify reinforcement, including all masonry reinforcement and slab reinforcement (WWF or reinforcing bar). Agent shall verify reinforcement has been chair/placed with proper clearances.

B. The Owner shall employ a Testing Laboratory to inspect, sample and test the materials and the production of concrete and to submit test reports. Masonry testing shall be performed by technicians certified by the Maine Concrete Technician Certification Board and/or ACI Concrete Field Testing Technician Grade I.

1. Verify that grouting operations are performed and grout is placed and consolidated in accordance with the specifications.

2. Verify that contractor is using approved admixtures for grout.

3. Sample Fresh Grout: ASTM C-172, except modified for slump to comply with ASTM C-94.

a. Slump: ASTM C-143; one (1) test for each grout load at point of discharge; one (1) test for each set of compressive strength test specimens.

b. Air Content: ASTM C-173; volumetric method or ASTM C-231 pressure method for normal weight concrete; one (1) for each of compressive strength test specimens.

c. Grout Temperature; For each load, at time of arrival, at point of discharge test hourly when air temperature is 40 degree F and above; and each time a set of compression test specimens are made.

d. Compression Test Specimens: ASTM C-31; one (1) set of four (4) standard cylinders for each truck or mixer load of grout taken when load is 50% discharged from truck, unless other wise directed. Mold/store cylinders for laboratory cured test specimens except when field-cure test specimens are required.

e. Refer to Section 03300, "Cast-In-Place Concrete" for remaining test requirements. Substitute therein the work "grout" for the word "concrete".

END OF SECTION

SECTION 05 12 00 – STRUCTURAL STEEL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. The drawings and general conditions of the contract including General and Supplementary Conditions and other Division 1 Specification sections apply to work of this section.

B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK:

A. Extent of structural steel work is shown on drawings, including schedules, notes and details to show size and location of members, typical connections, and type of steel required.

B. Structural steel is that work defined in AISC "Code of Standard Practice" and as otherwise shown on drawings.

1.03 RELATED WORK

1. Section 05 20 00 – Open Web Steel Joists

2. Section 05 30 00 – Metal Deck

3. Section 05 50 00 - Metal Fabrications

1.04 QUALITY ASSURANCE:

A. Codes and Standards: Comply with latest provisions of the following, except as otherwise indicated:

1. AISC "Code of Standard Practice for Steel Buildings and Bridges", Latest Edition.

a. The provisions of Section 10, "Architecturally Exposed Structural Steel", apply to exposed steel elements for this project. In addition, exposed welds shall be ground to provide smooth surface.

b. Exclude the word "structural" in reference to the "Design Drawings" in section 3.1 of the Code.

2. AISC "Specification for Structural Steel Buildings", including "Commentary" and Supplements issued thereto.

3. AISC "*Specifications for Structural Joints using ASTM A 325 or A 490 Bolts"* approved by the Research Council on Structural Connections of the Engineering Foundation.

4. AISC 341, "Seismic Provisions for Steel Buildings".

5. AWS D1.1 - "Structural Welding Code" - Steel.

6. AWS D1.3 - "Structural Welding Code" - Sheet Steel.

7. ASTM A6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."

8. "Code of Federal Regulations, Part 1926" per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).

B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS D1.1 "Standard Qualification Procedure."

1. Provide certification that welders to be employed in work have satisfactorily passed AWS D1.1 qualification tests and maintained a current certification. Current certification and/or continuity log shall be submitted and be available in the field.

2. If re-certification of welders is required, retesting will be the Contractor's responsibility.

C. Fabricator Qualifications: Fabricator must be a member of the American Institute of Steel Construction (AISC), be certified for SBD – Conventional Steel Building Structures, STD – Standard for Steel Building Structures. Fabricator shall be certified at time of bidding and for duration of project.

1.05 SUBMITTALS

A. Unless otherwise specified, submittals required in this section shall be submitted for review. Submittals shall be prepared and submitted in accordance with this section and Division 1.

B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner's Notice to Proceed.

C. All submittals shall be reviewed and returned to the Architect within 10 working days.

D. INCOMPLETE SUBMITTALS WILL NOT BE REVIEWED.

E. Submittals not reviewed by the General Contractor prior to submission to the Engineer will not be reviewed. Include on the submittal statement or stamp of approval by

Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in Division 1 have been complied with.

F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.

G. Hardcopy Submittals: Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.

H. Electronic Submittals:

1. Contractor shall include in the submittal schedule an indication of submittals that are intended to be submitted electronically. Upon receipt of the submittal schedule, the Engineer reserves the right to indicate submittals that will not be accepted electronically. Paper copies of such submittals shall be furnished as referenced in this specification.

2. The Engineer reserves the right to require paper copies of submittals that are received electronically. Provide Engineer one (1) paper copies in addition to the electronic submittal. Paper copy will be retained and electronic copy will be returned. Review cycle for such submittals shall not commence until such time that the paper copies are received.

3. Electronic Submittals shall be submitted in Protected Document Format (PDF) compatible with Adobe Acrobat Professional version 7.0 or later. Electronic files shall not be broken into smaller individual files. File sizes too large to process email or within a file transfer protocol (FTP) site shall be provided on a CD.

4. The submission of submittals electronically does not relieve the contractor of their responsibility to review the submittal prior to transmission to the Engineer. Electronic Submittals shall include contractor comments, and a statement and/or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with. Electronic submittals without the Contractor's approval will be rejected and returned.

5. The Engineer assumes no responsibility for the printed reproduction of submittals reviewed electronically, transmission errors or returned electronic submittals that become corrupted or are otherwise not accessible by the Contractor's or Subcontractor's computer hardware and/or software.

I. Product Data: Submit producer's or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

1. Structural steel certified mill reports for each grade of steel covering chemical and physical properties and yield strengths.

2. High-strength bolts (each type), including nuts and washers.

3. Structural steel primer paint (where applicable).

4. Structural steel top coat paint (where applicable). (Refer to Division 9.)

5. AWS D1.1 Welder certifications.

6. Expansion/Adhesive Anchors (coordinate with section 03 30 00).

J. Fabricator's Quality Control Procedures: Fabricator shall submit their written procedural and quality control manuals, and evidence of periodic auditing of fabrication practices by an approved inspection Agency.

K. Fabricator's Certificate of Compliance: At completion of fabrication, fabricator shall submit a certificate of compliance stating that the work was performed in accordance with the construction documents.

L. Shop Drawings:

1. Shop Drawing Review: Electronic files of structural drawings will not be provided to the contractor for preparation of shop drawings. Reproduction of any portion of the Construction Documents for use as Shop drawings and/or Erection Drawings is prohibited. Shop drawings and/or Erection drawings created from reproduced Construction Documents will be returned without review.

    a. Review of the shop drawings will be made for the size and arrangement of the members and strength of the connections. Conformance of the Shop Drawings to the Contract Drawings remains the responsibility of the General Contractor. Engineer's review in no way relieves the General Contractor of this responsibility.

    b. Shop drawings will not be reviewed as partial submittals. A complete submittal shall be provided and shall include; erection and piece drawings indicating all members, braced frames, moment frames and connections. Incomplete submittals will not be reviewed.

2. Alternate Connection Design: Connections for all beam, column, braced frame, and moment connections not tabulated in the AISC "Manual of Steel Construction" (ASD or LRFD) have been designed and detailed in the drawings. Alternate connection design shall be allowed only with prior approval of the Structural Engineer. If such approval is granted, all redesigned connections shall be designed by the fabricator's engineer, registered in the State of Maine. Calculations for redesigned connections shall be signed and sealed.

3. Test Reports: Submit copies of reports of tests conducted on shop and field bolted and welded connections. Include data on type(s) of test conducted and test results.

1.06 DELIVERY, STORAGE AND HANDLING:

A. Deliver materials to site at such intervals to insure uninterrupted progress of work.

B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place, in ample time to not delay work.

C. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

D. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Steel materials shall be stored in a manner to avoid ponding of precipitation on members. Repair or replace damaged materials or structures as directed.

PART 2 PRODUCTS

2.01 MATERIALS:

A. Structural Steel Shapes, Plates and Bars (U.N.O): ASTM A 36 minimum, higher strength steel is acceptable.

B. Structural Steel Hot Rolled Wide Flange Shapes: ASTM A 992 Grade 50 (ASTM A572 Grade 50 with special requirements per AISC Technical Bulletin #3, dated March 1997)

C. Steel Tube: ASTM A 500, Grade B, Fy = 46 ksi.

D. Steel Pipe: ASTM A 53, Grade B.

E. Anchor Bolts: ASTM F1554, Grade 36 weldable steel, unless noted otherwise on drawings. Anchor rods that are to be exposed to weather, located in unheated enclosures, or in contact with pressure treated lumber shall be hot dipped galvanized. All anchor bolts shall be headed or double nutted. “J” or “L” type anchor bolts are not permitted. Unless otherwise noted, specified embedment it to top face of head or nut.

F. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular low-carbon steel bolts and nuts. Provide hexagonal heads and nuts for all connections.

G. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:

1. Quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A325 or ASTM A490. Refer to drawings for diameter.

2. Direct tension indicator washers or bolts may be used at Contractor’s option.

3. Provide hot-dipped galvanized fasteners at relieving angles.

H. Steel Shear Studs: Headed type manufactured from steel conforming to ASTM A108 Grade C1015 by KSM or Nelson. Refer to Drawings for diameter and length.

I. Deformed Bar Anchors, manufactured by Nelson and attached to structural steel. Refer to drawings for diameter and length.

J. Electrodes for Welding:

1. Minimum 70 ksi electrodes. Filler material shall meet the grouping requirements per AWS D1.1 Table 3.1 for matching strength of connected materials.

2. All filler metal used welding shall meet the following Charpy V-Notch (CVN) requirements.

a. 20 ft-lb at 0 degrees Fahrenheit unless noted otherwise.

b. 20 ft-lb at -20 degrees Fahrenheit and 40 ft-lb at 70 degrees Fahrenheit at all complete joint penetration (CJP) groove welds.

K. Structural Steel Coatings shall be as specified in the Structural Steel Coatings section of this specification, and as specified in Division 9.

L. Non Shrink Cement-Based Grout: See Section 03 30 00

M. Drilled Anchors: Expansion and adhesive by HILTI, SIMPSON or POWERS/RAWL as indicated on the drawings.

2.02 FABRICATION:

A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings.

1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs and other defects.

B. Connections: Weld or bolt shop connections, as indicated.

1. Provide field bolted connections, except where welded connections or other connections are indicated.

2. Provide high-strength threaded fasteners for principal bolted connections, except where unfinished bolts are indicated.

C. High-Strength Bolted Connection: Install high-strength threaded fasteners in accordance with AISC "Specification for Structural Joints using ASTM A 325 or A 490 Bolts". Unless otherwise indicated, all bolted connections are to be tightened to the snug tight condition as defined by AISC.

D. Welded Construction: Comply with AWS Codes for procedures, appearance and quality of welds, and methods used in correcting welding work.

E. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on final shop drawings.

F. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

G. Fabricator, Erector and General Contractor shall coordinate safety requirements for the project, in accordance with OSHA Part 1926. Provide all necessary pieces and fabrications as required to safely erect and access the structure for the duration of project construction.

H. Camber, if any, is indicated on the drawings. Camber indicated is the required camber at time of erection. Contractor shall survey camber prior to placing metal deck.

2.03 STRUCTURAL STEEL COATINGS

A. Coordinate coating requirements with the Architect, and with Division 9 of the specifications.

B. To the greatest extent possible, structural steel coatings shall be shop applied.

C. Coordinate steel markings with coating system to eliminate "bleed through" on steel permanently exposed to view.

D. Galvanizing, priming and painting for structural steel permanently exposed to view shall meet the requirements of Section 10 of the Code of Standard Practice, "Architecturally Exposed Structural Steel".

E. Provide venting/drainage holes in closed tubular members to be hot-dipped galvanized. Holes shall be provided in a location hidden from view in the final condition and in a manner that will not reduce the strength of the member. Hole locations shall be clearly indicated on the Shop Drawings and are subject to review by the Architect.

F. Follow manufacturer's installation and safety instructions when applying coatings. Adhere to recoat time recommendations set forth by manufacturer.

G. General: Shop priming of structural steel is not required for heated, interior steel not exposed to view unless noted otherwise.

H. Steel which is to receive spray-on fireproofing shall not to be primed or painted, unless specified by the Architect.

I. Coatings: All exterior steel and/or steel permanently exposed to view shall receive a coating. Unless noted otherwise, refer to Division 9 specifications for products and surface preparation requirements.

J. Brick masonry loose lintels and relieving angle assemblies, including fasteners, shall be hot dipped galvanized, unless noted otherwise on the Architectural Drawings

K. Unheated structural steel to be enclosed with architectural finishes, including but not by limitation, canopy members and/or roof pop-up members shall be primed with rust inhibitive alkyd primer, Tnemec Series 10 unless noted otherwise. Follow manufacturer's instructions for surface preparation and application. Substitution shall be equal to the above specified products, and shall be submitted for review.

L. Steel Embedded in Concrete/Below Grade: Steel which is embedded in concrete, below grade/slab level, or as otherwise indicated on the drawings, shall be field painted with cold-applied asphalt emulsion complying with ASTM D 1187. Paint embedded areas only. Do not paint surfaces which are to be welded until welding is complete.

M. Field Touch-up: Touch-up all paint and galvanizing damage, including but not by limitation, damage caused during shipping, erection, construction damage, and field welded steel. See Division 9 specifications for additional requirements.

PART 3 EXECUTION

3.01 ERECTION:

A. General: Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

B. Erection Procedures: Comply with "Code of Federal Regulations, Part 1926" per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).

C. Surveys: Employ a Registered Land Surveyor to verify elevations of concrete bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Architect and Structural Engineer. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been approved by Structural Engineer of Record. Additional surveys required to verify out-of-alignment work and/or corrective work shall be performed at the contractor's expense.

D. Temporary Shoring and Bracing: This is the sole responsibility of the Contractor. Provide temporary shoring and bracing members with connections of sufficient strength to support imposed loads. Remove temporary members and connections when all permanent members are in place, and all final connections are made, including the floor and roof diaphragms. Provide temporary guy lines to achieve proper alignment of

structures as erection proceeds. Comply with OSHA Standard referenced previous. Retain the services of a Specialty Structural Engineer (Not the Engineer of Record) to design specialty shoring and bracing.

E. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place work.

1. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

2. Welding to anchor bolts for corrective measures is strictly prohibited without prior written approval from the Engineer.

F. Setting Plates and Base Plates:

1. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations. Refer to division 3 of the project Specifications for anchor bolt installation requirements in concrete.

2. Clean concrete bearing surfaces of bond-reducing materials. Clean bottom surface of setting and bearing plates.

3. Set loose and attached base plates for structural members on wedges or other adjusting devices.

4. Pack non-shrink grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure. For proprietary grout materials, comply with manufacturer's instructions.

G. Concrete slabs that are part of elevated floors framing systems shall achieve 28-day design strength prior to the application of any superimposed loads such as curtain walls, masonry veneer, mechanical equipment and stairs. Additional testing beyond that specified in division 3 required to verify the concrete strength prior to application of superimposed loads shall be done at the Contractor's expense.

H. When installing expansion bolts or adhesive anchors, the contractor shall take measures to avoid drilling or cutting any existing reinforcement or damaging adjacent concrete. Holes shall be blown clean with compressed air and/or cleaned per manufacturer's recommendations prior to the installation of anchors.

I. Field Assembly:

1. Set structural frames accurately to lines and elevations indicated.

2. Align, adjust, level and plumb members of complete frame in to the tolerances indicated in the AISC Code of Standard Practice and in accordance with OSHA regulations.

3. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly.

4. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

5. Splice members only where indicated and accepted on shop drawings.

6. Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

7. Composite shear studs / deformed bar anchors shall be installed using stud welding process with an appropriately sized insulating ferrule. Fillet welding of shear studs is not permitted. Ferrules shall be broken free from the shear studs and removed from the deck surface along with all other debris.

J. Coat columns, base plates, and brace elements encased in concrete and/or below grade with cold-applied asphalt emulsion. Coordinate coating with concrete work.

K. Erection bolts: Remove erection bolts. On exposed welded construction and at all braced frame members fill holes with plug welds and grind smooth at exposed surface.

L. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members which are not under stress, as accepted by the Engineer of Record. Finish gas-cut sections equal to a sheared appearance when permitted.

M. Coating Damage: Touch up shop applied paint or galvanizing whenever damaged or bare. See “Coatings” sections for additional requirements.

N. Field Cut Beam Web Penetrations:

1. Field cut beam web penetrations are not permitted without written approval from the Structural Engineer.

2. Gas cutting torches are not permissible for cutting beam web penetrations without written approval from the Structural Engineer.

3. Beams with field cut beam web penetrations may require reinforcement, subject to the evaluation by the Structural Engineer.

4. The evaluation of field cut web penetrations by the Structural Engineers for Design-Build Subcontractors, including but not by limitation, Mechanical, Electrical, Plumbing and Sprinkler Subcontractors shall be compensated by the General Contractor or Design-Build Subcontractor.

5. The cost of executing field cut web penetrations and the associated beam reinforcement for Design-Build Subcontractors, including but not by limitation, Mechanical, Electrical, Plumbing and Sprinkler Subcontractors shall be paid for by the General Contractor or Design-Build Subcontractor.

6. Field cut beam web penetrations may not be permitted in certain locations, subject to the evaluation by the Structural Engineer.

O. Welders shall have current evidence of passing and maintaining the AWS D1.1 Qualifications test available in the field.

P. Welding electrodes, welding process, minimum preheat and interpass temperatures shall be in accordance with AISC and AWS specifications. Any structural steel damaged in welding shall be replaced.

Q. Field Welded Moment Connections:

1. Welding of Moment Connections shall meet the requirements of FEMA 353.

2. Backing materials for top and bottom flanges for field welded moment connections shall be removed, backgouge the weld root, and apply a reinforcing fillet weld.

3. Where top flange steel backing materials are utilized, the backing may be left in place. In this case, the backing material shall be welded with a reinforcing fillet weld.

3.02 QUALITY CONTROL:

A. General: Contractor is responsible for maintaining quality control in the field and for providing a structure that is in strict compliance with the Contract Documents.

1. Required inspection and testing services are intended to assist the Contractor in complying with the Contract Documents. These specified services, however, do not relieve the Contractor of his responsibility for compliance, nor are they intended to limit the Contractor's quality control efforts in the field.

B. Testing: Owner shall engage an Independent Testing Agency to inspect all high-strength bolted and welded connections, to perform tests and prepare reports of their findings. All connections must pass these inspections prior to the installation of subsequent work which they support.

1. Testing agency shall conduct tests and state in each report which specific connections were examined or tested, whether the connections comply with requirements, and specifically state any deviations therefrom.

2. Contractor shall provide access for testing agency to places where structural steel work is being fabricated, produced or erected so that required inspection and testing can be accomplished. Testing agency may inspect structural steel at plant

before shipment. The Engineer, however, reserves the right, at any time before final acceptance, to reject material not complying with specified requirements.

C. Inspection Requirements (to be performed by the Independent Testing Agency):

1. Bolted Connections: Inspect all bolted connections in accordance with procedures outlined in the AISC "Specification for Structural Joints using ASTM A325 or A490 Bolts.

2. Snug Tight Bolted Connections:

   a. The inspector shall monitor the installation of bolts to determine that all plies of connected material have been drawn together and that the selected procedure is used to tighten all bolts.

   b. If the inspector does not monitor the installation of bolts, he shall visually inspect the connection to determine that all plies of connected material have been drawn together and conduct tests on a sampling connection bolts to determine if they have been tightened to the snug tight condition. The test sample shall consist of 10% of the bolts in the connection, but not less than two bolts, selected at random. If more than 10% of the tested bolts fail the initial inspection, the engineer reserves the right to increase the number of bolts tested.

3. Slip Critical Bolted Connections:

   a. The inspector shall monitor the calibration of torquing equipment and the installation of bolts to determine that all plies of connected material have been drawn together and that the selected procedure is used to tighten all bolts.

   b. If the inspector does not monitor the calibration or installation procedures, he shall test all bolts in the affected connection using a manual torque wrench to assure that the required pretension has been reached.

4. Field Welded Connections: inspect and test during fabrication of structural steel assemblies, and during erection of structural steel all welded connections in accordance with procedures outline in AWS D1.1. Record types and location of defects found in work. Record work required and performed to correct deficiencies.

   a. Certify welders and conduct inspections and tests as required. Submit welder certifications to Engineer of Record. Perform visual inspection of all welds. Primary and secondary welds, including fillet welds, full penetration welds, and deck puddle welds, applied in the field and/or shop, shall be visually inspected.

   b. Welds deemed questionable by visual inspection shall receive non-destructive testing. In addition, all partial and full penetration welds, and

any other welds indicated on the drawings are to receive non-destructive testing. Non-destructive testing methods include the following:

1. Radiographic Inspection (RT): ASTM E 94 and ASTM E 142; minimum quality level "2-2T".

2. Ultrasonic Inspection (UT): ASTM E 164.

3. Magnetic Particle (MT) inspection procedures may be utilized at the inspectors discretion in addition to RT or UT inspection. MT procedures shall not replace RT or UT procedures without permission from the Structural Engineer.

c. All welds deemed unacceptable shall be repaired and retested at the Contractor's expense.

D. Composite Shear Studs/Deformed Bar Anchors:

1. Verify shear stud quantity and arrangement.

2. Visually inspect stud weld. A weld less than 360 degrees is cause for further testing by bending to 15 degrees per item 2 below. Strike all studs with a 3 pound sledge hammer with moderates force. Studs shall make a ringing sound when struck with the hammer. If a stud or studs breaks free, or fails to make a ringing sound, further testing shall be performed per item 4.

3. One stud in 100 shall be tested by bending to 15 degrees from vertical, and one stud in 200 shall be tested by bending to 30 degrees from vertical. Single bent studs may be left bent. Failure of stud weld during bend testing is cause for further testing per item 4.

4. When failure occurs during bend testing, additional bend testing shall be performed on 10 studs to either side of failed stud. Bend studs to 30 degrees from vertical. If failure occurs during additional testing, continue testing in series of 10 studs beyond failed stud until no failure occurs.

5. Straighten all studs that were bent in multiple stud testing. Replace all studs that fail.

E. Inspector shall verify that all ferrules are removed when applicable and that metal deck is free of debris prior to concrete placement.

F. Testing and inspection reports shall be submitted to the Owner, Architect and Engineer within 48 hours of completion of each test or inspection.

G. Nonconforming Work: Contractor shall be responsible for correcting deficiencies in structural steel work which inspections laboratory test reports have indicated to be not in compliance with requirements. Additional tests and/or surveys shall be performed, at the Contractor's expense, as may be necessary to show compliance of corrected work.

Any costs associated with the Engineer's review and disposition of faulty works shall be borne by the Contractor.

END OF SECTION

SECTION 05 20 00 – OPEN WEB STEEL JOIST

PART 1 GENERAL

1.01 RELATED DOCUMENTS:

A. The drawings and general conditions of the contract including General and Supplementary Conditions and other Division 1 Specification sections apply to work of this section.

B. Examine all other sections of the Specifications for requirements which affect work of this section whether or not such work is specifically mentioned in this section.

C. Coordinate work with that of all trades affecting or affected by work of this section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK:

A. Extent of steel joists is shown on drawings, including basic layout and type of joists required.

B. Related work specified elsewhere:

1. Section 05 12 00 - Structural Steel

2. Section 05 30 00 - Metal Decking

3. Section 05 50 00 - Metal Fabrications

1.03 QUALITY ASSURANCE:

A. Codes and Standards:

1. Steel Joist Institute (SJI) Standard Specifications, Load Tables and Weight Tables-latest revisions-for:

a. K-Series Open Web Steel Joists as designated on the Contract Drawings.

b. LH/DLH Series Open Web Long Span Steel Joists as designated on the Contract Drawings.

2. Steel Joist Institute (SJI) Recommended Code of Standard Practice for Steel Joists and Joist Girders, latest revision.

3. AWS D1.1 "Structural Welding Code" – Steel

4. AWS D1.3 "Structural Welding Code" - Sheet Steel

5. “Code of Federal Regulations, Part 1926” per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).

B. Qualification for Welding Work: Qualify welding processes and welding operators in accordance with AWS D1.1 "Standard Qualification Procedure".

1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.

2. If recertification of welders is required, retesting will be the Contractor's responsibility.

1.04 SUBMITTALS:

A. Unless otherwise specified, submittals required in this section shall be submitted for review. Submittals shall be prepared and submitted in accordance with this section and Division 1.

B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner’s Notice to Proceed.

C. All submittals shall be reviewed and returned to the Architect within 10 working days.

D. Incomplete submittals will not be reviewed.

E. Submittals not reviewed by the General Contractor prior to submission to the Engineer will not be reviewed. Include on the submittal statement or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in Division 1 have been complied with.

F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.

G. Hardcopy Submittals: Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.

H. Electronic Submittals:

1. Contractor shall include in the submittal schedule an indication of submittals that are intended to be submitted electronically. Upon receipt of the submittal schedule, the Engineer reserves the right to indicate submittals that will not be accepted electronically. Paper copies of such submittals shall be furnished as referenced in this specification.

2. The Engineer reserves the right to require paper copies of submittals that are received electronically. Provide Engineer one (1) paper copies in addition to the electronic submittal. Paper copy will be retained and electronic copy will be returned. Review cycle for such submittals shall not commence until such time that the paper copies are received.

3. Electronic Submittals shall be submitted in Protected Document Format (PDF) compatible with Adobe Acrobat Professional version 7.0 or later. Electronic files shall not be broken into smaller individual files. File sizes too large to process email or within a file transfer protocol (FTP) site shall be provided on a CD.

4. The submission of submittals electronically does not relieve the contractor of their responsibility to review the submittal prior to transmission to the Engineer. Electronic Submittals shall include contractor comments, and a statement and/or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with. Electronic submittals without the Contractor's approval will be rejected and returned.

5. The Engineer assumes no responsibility for the printed reproduction of submittals reviewed electronically, transmission errors or returned electronic submittals that become corrupted or are otherwise not accessible by the Contractor's or Subcontractor's computer hardware and/or software.

I. Product Data: Submit manufacturer's specifications and installation instructions for each type of joist and accessories. Include manufacturer's certification that joists comply with SJI Standard Specifications. Product data shall include:

   1. Joist steel component certified mill reports for each grade of steel covering chemical and physical properties and yield strengths.

   2. Steel joist primer paint.

   3. Welder certifications

J. Shop Drawings:

1. Shop Drawing Review: Electronic files of structural drawings will not be provided to the contractor for preparation of shop drawings. Reproduction of any portion of the Construction Documents for use as Shop drawings and/or Erection Drawings is prohibited. Shop drawings and/or Erection drawings created from reproduced Construction Documents will be returned without review.

    a. Review of the shop drawings will be made for the size and arrangement of the members and strength of the connections. Conformance of the Shop Drawings to the Contract Drawings remains the responsibility of the General Contractor. Engineer's review in no way relieves the General Contractor of this responsibility.

    b. Shop drawings will not be reviewed as partial submittals. A complete submittal shall be provided and shall include; erection and piece drawings indicating all joist members, bridging, connections and accessories. Incomplete submittals will not be reviewed.

2. Design

    a. Unless noted otherwise, steel joists shall be designed to support the uniformly distributed loads per the "Standard Load Tables" by the Steel Joist Institute. An allowance for MEP equipment and architectural component loads has been included in the uniformly distributed design loads. The joist design shall allow a 150 pound concentrated hanger load be applied at any location along either the top or bottom chord of the joists that is part of the MEP equipment and architectural component allowance, without additional reinforcement.

    b. Calculations for SP joists: Submit design calculations for special steel joists indicated on Contract Drawings by SP designation, or as otherwise noted. Submit calculations stamped by a Registered Professional Engineer licensed to practice in the State of Maine. Design joists for the loads indicated on the Contract Drawings with a vertical deflection due to live load not exceeding:1/240 of the span for all roof joists. Concentrated loads applied to SP joists are to be applied as Live Loads unless otherwise indicated.

3. Evidence of in-plant inspections: Per SJI requirements, each manufacturer shall verify his ability to manufacturer steel joists through periodic in-plant inspections. Inspections shall be performed by an independent testing agency. Submit evidence of participation in SJI in-plant inspections program.

4. Test Reports: Submit copies of reports of tests conducted on shop and field bolted and welded connections. Include data on type(s) of test conducted and test results.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Deliver materials to site at such intervals to insure uninterrupted progress of work.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

C. Deliver, store and handle steel joists as recommended in SJI Standard Specifications and SJI Technical Digest #9 “Handling and Erection of Steel Joists and Joist Girders”. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Handle and store joists in a manner to avoid deforming members and to avoid excessive stresses. Protect joist members and packaged materials from corrosion and deterioration.

PART 2 PRODUCTS

2.01 MATERIALS:

A. Steel: Comply with SJI Standard Specifications.

B. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular hexagon type, low carbon steel

C. High-Strength Bolts and Nuts: ASTM A325, Type I, heavy hex structural bolts, heavy hex nuts and hardened steel washers.

D. Steel Primer Paint: Manufacturer's standard shop paint conforming to Steel Structures Painting Council Specification: SSPC-Paint 15 “Steel Joist Shop Primer”, or a shop paint which meets the minimum performance requirements of SSPC-Paint 15.

2.02 FABRICATION:

A. General: Fabricate steel joists in accordance with SJI Standard Specifications.

B. Holes in Chord Members: Provide holes in chord members where shown for securing other work to steel joists; deduct area of holes from the area of chord when calculating strength of member.

C. Openings in Web: Coordinate openings in joist and joist girder webs to allow through passage of HVAC, sprinklers, etc. in locations shown on the drawings.

D. Extended Ends: Provide extended ends on joists where shown and where deck extends beyond supports, complying with manufacturer's standards and requirements of applicable SJI Standard Specifications and Load Tables. Unless noted otherwise, “R” type extended ends shall be utilized.

E. Uplift: Roof joists shall be designed for a net uplift of 15 psf.

F. Camber: Camber in accordance with SJI Standard Specifications. Joists shall not be manufactured with negative camber.

G. Bridging:

1. Provide horizontal or diagonal type bridging for "open web" joists, complying with SJI Standard Specifications and any additional requirements shown on Contract Drawings. Bridging layout shall be clearly indicated on the shop drawings.

2. Provide bridging anchors for ends of bridging lines terminating at walls or beams.

3. Provide bottom chord bridging for uplift, in accordance with SJI Standard Specifications, and SJI Technical Digest #6 “Structural Design of Steel Roof Joists to Resist Uplift Loads” when the above noted uplift load is greater than zero.

H. End Anchorage: Provide end anchorages to secure joists to adjacent construction, complying with SJI Standard Specifications, unless otherwise indicated. Roof joists shall be anchored to resist the above noted uplift force.

1. Minimum final connection each side of joist seat, unless noted otherwise, shall be as follows:

a. “K” Joists: 2 inches, 1/8” fillet weld or (2) 1/2" diameter A307 Bolts

b. “LH” Joists: 2 inches, 1/4" fillet weld, or (2) 3/4" diameter A325 Bolts (slip critical)

I. Shop Painting:

1. Remove loose scale, heavy rust and other foreign materials from fabricated joists and accessories before application of shop paint in accordance with SSPC-SP 1 and SSPC-SP 2.

2. Apply one shop coat of primer paint, SSPC-Paint 15, or better, to steel joists 2.0 to 3.0 mils DFT (dry film thickness) measurement in accordance with SSPC-PA 2.

PART 3 EXECUTION

3.01 ERECTION:

A. General: Place and secure steel joists in accordance with SJI Standard Specifications, final shop drawings, and as herein specified. Comply with “Code of Federal Regulations, Part 1926” per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).

B. Placing Joists:

1. Do not start placement of steel joists until supporting work is in place and secured.

2. Place joists on supporting work, adjust and align in accurate location and spacing before permanently fastening.

3. Provide temporary bridging, connections and anchors to ensure lateral stability during construction.

C. Bridging: Install bridging simultaneously with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where terminating at walls or beams.

D. Fastening:

1. Joists at column lines shall be bolted with a minimum (2) 3/4" diameter A325 bolts in a slip critical type connection. Stabilizer plates welded to the columns shall be provided at the bottom chord angles at all column lines. Do not weld bottom chord angles to stabilizer plate unless noted otherwise.

2. Field weld joists to supporting steel framework in accordance with SJI Standard Specifications for type of joists used. Coordinate welding sequence and procedure with placing of joists.

3. Bolt joists to supporting steel framework in accordance with SJI Standard Specifications for type of joists used.

E. Reinforcement for Concentrated Loads: Reinforcing angles shall be applied for concentrated loads in excess of 150 pounds applied to joists. The reinforcing angles shall transfer the concentrated loads to a joist panel point. Unless noted otherwise, hung elements shall be attached to the joist top chords. Hangers and hanger accessories shall be designed by a Specialty Structural Engineer Registered in the State of Maine (Not the Engineer of Record).

F. Touch-up painting: Clean field welds, bolted connections, and abraded areas, and apply same type of primer paint as used in shop.

3.02 QUALITY CONTROL:

A. General: Contractor is responsible for maintaining quality control in the field and for providing a structure that is in strict compliance with the Contract Documents.

B. Required inspection and testing services are intended to assist the Contractor in complying with the Contract Documents. These specified services, however, do not relieve the Contractor of his responsibility for compliance, nor are they intended to limit the Contractor's quality control efforts in the field.

C. Testing: Owner shall engage an Independent Testing Agency to inspect all puddle welded connections, to perform tests and prepare reports of their findings. All connections must pass these inspections prior to the installation of subsequent work which they support.

D. Joist Inspection Requirements (to be performed by the Independent Testing Agency):

E. Testing:

1. Joist connections, bringing connections and field splices shall be tested as indicated in specification section 05120. Work found to be defective will be removed and replaced at the Contractor's expense.

2. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests. If re-certification of welders is required, re-testing will be the Contractor's responsibility.

END OF SECTION

SECTION 05 30 00 – METAL DECKING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. The drawings and general conditions of the contract including General and Supplementary Conditions and other Division 1 Specification sections apply to work of this section.

B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK

A. Extent of metal floor and roof deck is shown on the drawings and includes type VL composite floor deck, roof deck, cell closures, end plates, pour stops with vertical leg return lip, metal lath column closures, composite finish strips, welding washers and sump plates or pans.

1.03 RELATED WORK

1. Section 05 12 00 - Structural Steel

2. Section 05 20 00 – Open Web Steel Joists

3. Section 05 50 00 - Metal Fabrications

1.04 QUALITY STANDARDS

A. Codes and Standards: Comply with provisions of the following codes and standards, except where more stringent requirements are indicated or specified:

1. AISI "Specification for the Design of Cold Formed Steel Structural Members”.

2. AWS D1.1 "Structural Welding Code" - Steel

3. AWS D1.3 "Structural Welding Code" - Sheet Steel

4. Steel Deck Institute (SDI) " Design Manual for Floor Decks and Roof Decks”.

5. “Code of Federal Regulations, Part 1926” per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).

B. Qualification of field welding: Qualify welding process and welding operators in accordance with AWS D1.1 "Standard Qualification Procedure."

1.05 SUBMITTALS

A. Unless otherwise specified, submittals required in this section shall be submitted for review. Submittals shall be prepared and submitted in accordance with this section and Division 1.

B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner's Notice to Proceed.

C. All submittals shall be reviewed and returned to the Architect within 10 working days.

D. Incomplete submittals will not be reviewed.

E. Submittals not reviewed by the General Contractor prior to submission to the Engineer will not be reviewed. Include on the submittal statement or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in Division 1have been complied with.

F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.

G. Hardcopy Submittals: Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.

H. Electronic Submittals:

1. Contractor shall include in the submittal schedule an indication of submittals that are intended to be submitted electronically. Upon receipt of the submittal schedule, the Engineer reserves the right to indicate submittals that will not be accepted electronically. Paper copies of such submittals shall be furnished as referenced in this specification.

2. The Engineer reserves the right to require paper copies of submittals that are received electronically. Provide Engineer one (1) paper copies in addition to the electronic submittal. Paper copy will be retained and electronic copy will be returned. Review cycle for such submittals shall not commence until such time that the paper copies are received.

3. Electronic Submittals shall be submitted in Protected Document Format (PDF) compatible with Adobe Acrobat Professional version 7.0 or later. Electronic files shall not be broken into smaller individual files. File sizes too large to process email or within a file transfer protocol (FTP) site shall be provided on a CD.

4. The submission of submittals electronically does not relieve the contractor of their responsibility to review the submittal prior to transmission to the Engineer. Electronic Submittals shall include contractor comments, and a statement and/or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with. Electronic submittals without the Contractor's approval will be rejected and returned.

5. The Engineer assumes no responsibility for the printed reproduction of submittals reviewed electronically, transmission errors or returned electronic submittals that become corrupted or are otherwise not accessible by the Contractor's or Subcontractor's computer hardware and/or software.

I. Product Data: Submit manufacturer's specifications and installation instructions for each type of decking and accessories. Include manufacturer's certification as may be required to show compliance with these specifications.

J. Shop Drawings:

1. Shop Drawing Review: Electronic files of structural drawings **will not** be provided to the contractor for preparation of shop drawings.

a. Submit detailed drawings showing layout and types of deck panels, galvanizing, shop paint, anchorage details, and conditions requiring closure panels, supplementary framing, sump pans, cant strips, cut openings, special jointing, and all other accessories. Conformance of the Shop Drawings to the Contract Drawings remains the responsibility of the General Contractor. Engineer's review in no way relieves the General Contractor of this responsibility.

b. Shop drawings will not be reviewed as partial submittals. A complete submittal shall be provided and shall include; erection and piece drawings. Incomplete submittals will not be reviewed**.**

1.06 DELIVERY, STORAGE AND HANDLING:

A. Deliver materials to site at such intervals to insure uninterrupted progress of work.

B. Store materials to permit easy access for inspection and identification. Keep deck sheets off ground, using pallets, platforms, or other supports. Protect deck sheets and packaged materials from corrosion and deterioration.

C. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Materials shall be stored in a manner to avoid ponding of precipitation on members. Repair or replace damaged materials or structures as directed.

PART 2 PRODUCTS

2.01 GENERAL:

A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. United Steel Deck
2. Wheeling Corrugating Co.
3. Epic Metals Corporation
4. Vulcraft

B. Materials:

1. Steel for Metal Deck Units:
    a. Floor Deck Units: ASTM A1008, Grade C, D or ASTM 653, Structural Quality, grade 40 or higher
    b. Roof Deck Units: ASTM A1008, Grade C, D, or E, or ASTM 653, Structural Quality, grade 33 or higher.
2. Miscellaneous Steel Shapes: ASTM A36 minimum.
3. Sheet metal Accessories: ASTM A526, commercial quality, galvanized.

C. Galvanizing: Conform to ASTM 924-94 with minimum coating class of G60 (Z180) as defined in ASTM A653-94.

D. Paint: Manufacturer's baked on, rust inhibitive paint, for application to metal surfaces which have been chemically cleaned and phosphate chemical treated.

E. Flexible closure Strips: Manufacturer standard vulcanized, closed-cell, synthetic rubber.

2.02 FABRICATION:

A. General: Form deck units in lengths to span 3 or more supports, unless otherwise noted on the drawings, with flush, telescoped or nested 2" laps at ends and interlocking or nested side laps, unless otherwise indicated. For roof deck units, provide deck configurations complying with SDI "Roof Deck Specifications," of metal thickness, depth and width as shown.

B. Metal Cover Plates: Fabricate metal cover plates for end-abutting floor deck units of not less than same thickness as decking. Form to match contour of deck units and approximately 6" wide.

C. Metal Closure Strips: Fabricate metal closure strips, cell closures, "Z" closures, column closures, pour stops, girder fillers and openings between decking and other construction, of not less than 0.045" min. (18 gage) sheet steel or as indicated on the drawings. Form to provide tight fitting closures at open ends of cells or flutes and sides of decking.

D. Pour Stops: Minimum material thickness shall be 18 gage or as indicate on drawings.. Fabricate vertical leg to accommodate specified slab thickness. Fabricate horizontal leg to minimize field cuts. Provide welded attachment sufficient to resist forces during concrete placement.

E. Roof Sump Pans: Fabricate from a single piece of 0.071" min. (14 gage) galvanized sheet steel with level bottoms and sloping sides to direct water flow to the drains, unless otherwise shown. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 3" wide. Recess pans not less than 1 1/2" below roof deck surface, unless otherwise shown or required by deck configuration. Holes for drains will be cut in the field.

F. Provide all pour stops and accessories necessary to contain concrete for poured concrete surfaces.

PART 3 EXECUTION

3.01 INSTALLATION:

A. Install deck units and accessories in accordance with manufacturer's recommendations and final shop drawings, and as specified herein.

B. Place deck units on supporting steel framework and adjust to final position with ends accurately aligned and bearing on supporting members before permanently fastened. Deck shall be in full contact with members parallel to ribs and attached as indicated. Do not stretch or contact side lap interlocks.

C. Place deck units in straight alignment for entire length of run of cells and with close alignment between cells at ends of abutting units.

D. Place deck units flat and square, secured to adjacent framing without warp or excessive deflection.

E. Coordinate and cooperate with the structural steel erector in locating decking bundles to prevent overloading of structural members.

F. Do not use decking units for storage or working platforms until permanently installed.

3.02 FASTENING:

A. Floor Deck: Fasten metal deck to supporting steel members as indicated on the Design Drawings: Each deck is to be fastened with a minimum of 5/8" diameter puddle welds spaced not more than 12" o.c. with a minimum of 2 welds per unit at each support. Secure deck units at 6” oc along brace lines, edge of building or at the edge of openings or deck discontinuity. Secure deck to each supporting member in ribs where sidelaps occur. Use welding washers where recommended by the deck manufacturer. Deck units shall bear over the ends of supports by a minimum of 1.5. Sidelaps: #10 Tek screws, 5/8” arc puddle welds or 1” long fillet welds, intervals not exceeding 36 inches. Crimped or button punched sidelaps are not permitted.

B. Roof Deck: Each deck is to be fastened with a minimum of 5/8" diameter puddle welds spaced in a 36/7 pattern (1.5B deck) with a minimum of 2 welds per unit at each support if incomplete sheet is utilized. Where support is parallel to support, at edge of building, at brace lines, at edge of opening or deck discontinuity provide puddle welds at 6” o.c. Secure deck to each supporting member in ribs where sidelaps occur. Deck units shall bear over the ends of supports by a minimum of 1.5”. Sidelaps: #10 Tek screws, 6 per span for B deck.

C. Welding: Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.

D. Uplift loading: Floor deck units are not required to resist uplift loads. Decking units used at the roof level shall be designed for a net uplift of 15 psf.

E. Cutting and Fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking.

F. Reinforcement at openings: Provide additional metal reinforcement and closures pieces as required for strength, continuity of decking and support of other work shown.

1. Deck penetrations affecting no more than (1) deck rib need not be reinforced.

2. For deck penetration affecting more than (1) deck rib, but less than 10", reinforce the opening with a 0.057" thick plate spanning between unaffected ribs, unless otherwise shown on the Design Drawings or supporting a piece of mechanical equipment (see item 3).

3. Reinforce deck penetrations larger than 10" with the structural frame described in the Design Drawings.

G. Joint Covers: Provide metal joint covers at abutting ends and changes in direction of floor deck units.

H. Roof Sump Pans: Place over openings provided in roof decking and weld to top decking surface. Space welds not more than 12" on center with at least 1 weld in each corner. Cut opening in roof sump bottom to accommodate drain size indicated.

I. Closure Strips: Provide metal closure strips at open uncovered ends and edges of roof decking, and in voids between decking and other construction. Weld into position to provide a complete decking installation.

J. Touch-Up Painting:

1. Painted Deck: After decking installation, wire brush, clean and paint scarred areas, welds and rust spots on top and bottom surfaces of decking units and supporting steel members.

a. Touch up painted surfaces with same type paint used on adjacent surfaces.

b. In areas where shop-painted surfaces are to be exposed, apply touch-up paint to blend into adjacent surfaces.

3.03 QUALITY CONTROL:

A. General: Contractor is responsible for maintaining quality control in the field and for providing a structure that is in strict compliance with the Contract Documents.

B. Required inspection and testing services are intended to assist the Contractor in complying with the Contract Documents. These specified services, however, do not relieve the Contractor of his responsibility for compliance, nor are they intended to limit the Contractor's quality control efforts in the field.

C. Testing: Owner shall engage an Independent Testing Agency to inspect all puddle welded connections, to perform tests and prepare reports of their findings. All connections must pass these inspections prior to the installation of subsequent work which they support.

D. Deck Testing Requirements (to be performed by the Independent Testing Agency):

1. Deck and accessory welding and/or attachments subject to inspection and testing. Work found to be defective will be removed and replaced at the Contractor's expense.

2. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests. If re-certification of welders is required, re-testing will be the Contractor's responsibility.

END OF SECTION

SECTION 05 40 00 – EXTERIOR COLD FORMED METAL FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. The drawings and general conditions of the contract including General and Supplementary Conditions and other Division 1 Specification sections apply to work of this section.

B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF THE WORK

A. Work specified within this Section includes, but is not necessarily limited to, the following:

1. Provide and install steel stud structural framing system at exterior walls as noted on the Drawings.

2. Providing and installing miscellaneous fasteners, hat channels, stiffeners, bridging, expansion joints, and accessories necessary to complete the work.

3. Provide and install support framing for tile siding system as noted on the Drawings.

4. Provide and install CFMF at stair tower soffit as noted on the Drawings.

5. Provide and install CFMF at canopies and sinage bands.

B. Related work specified elsewhere:

1. Interior Partition Walls: Division 9 - Gypsum Wallboard Systems

2. Exterior Gypsum Sheathing: Division 9 - Gypsum Sheathing

1.03 QUALITY ASSURANCE

A. Materials and installation shall conform to recommendations of the following publications:

1. American Iron and Steel Institute Cold-Formed Steel Design Manual, *"Specification for the Design of Cold-Formed Steel Structural Members"*.

2. AWS D1.1 "Structural Welding Code" - Steel.

3. AWS D1.3 "Structural Welding Code" - Sheet Steel.

4. ASTM C 954, Standard specification for steel drill screws for the application of gypsum board or metal plaster bases to steel studs from 0.033 in. to 0.112 in. thickness.

5. ASTM C 955, Standard Specification for Load-Bearing Steel Studs, Runners, and Bracing or Bridging, for Screw Application of Gypsum Board and Metal Plaster Bases.

6. ASTM C 1007 Standard Specification for installation of load bearing steel studs and related accessories.

7. Standard Specification for installation of load bearing steel studs and related accessories.

8. ASCE 7-05, "Minimum Design Loads for Building and Other Structures."

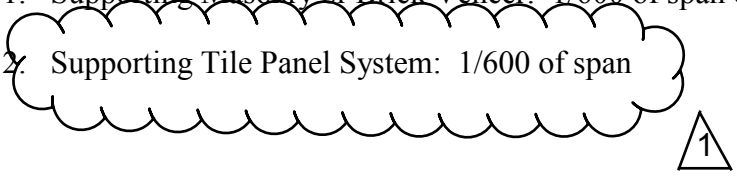
9. International Building Code, 2009 Edition

10. "Code of Federal Regulations, Part 1926" per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).

B. Maximum Allowable Deflections: Deflection limitations, (either horizontal or vertical), include the effect of studs only, not sheathing or facing material. Spans are measured in inches between the attachments to structural steel or concrete.

1. Supporting Masonry or Brick Veneer: 1/600 of span or 0.3 inches

2. Supporting Tile Panel System: 1/600 of span



C. Design wind pressures: Design wind pressures calculated in accordance with ASCE 7, Latest Edition for Components and Cladding, shall be used in the design of the exterior cold formed steel framing system. Utilize wind speed, importance factor and exposure indicated on the project General Notes.

D. Slip Track Tolerances: Where non-bearing light gage framing abuts the structure, provide a slip joint capable of accommodating the vertical movement of the structure. Slip joint gaps shall allow for 3/4" Live Load deflection of the supporting member. Minimum depth of slip track shall be 2". Minimum thickness shall be 14 gage. Slide clips are also acceptable where applicable.

1.04 SUBMITTALS

A. Unless otherwise specified, submittals required in this section shall be submitted for review. Submittals shall be prepared and submitted in accordance with this section and Division 1.

B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner's Notice to Proceed.

C. All submittals shall be reviewed and returned to the Architect within 10 working days.

D. Incomplete submittals will not be reviewed.

E. Submittals not reviewed by the General Contractor prior to submission to the Engineer will not be reviewed. Include on the submittal statement or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in Division 1 have been complied with.

F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.

G. Hardcopy Submittals: Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.

H. Electronic Submittals:

1. Contractor shall include in the submittal schedule an indication of submittals that are intended to be submitted electronically. Upon receipt of the submittal schedule, the Engineer reserves the right to indicate submittals that will not be accepted electronically. Paper copies of such submittals shall be furnished as referenced in this specification.

2. The Engineer reserves the right to require paper copies of submittals that are received electronically. Provide Engineer one (1) paper copies in addition to the electronic submittal. Paper copy will be retained and electronic copy will be returned. Review cycle for such submittals shall not commence until such time that the paper copies are received.

3. Electronic Submittals shall be submitted in Protected Document Format (PDF) compatible with Adobe Acrobat Professional version 7.0 or later. Electronic files shall not be broken into smaller individual files. File sizes too large to process email or within a file transfer protocol (FTP) site shall be provided on a CD.

4. The submission of submittals electronically does not relieve the contractor of their responsibility to review the submittal prior to transmission to the Engineer. Electronic Submittals shall include contractor comments, and a statement and/or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with. Electronic submittals without the Contractor's approval will be rejected and returned.

5. The Engineer assumes no responsibility for the printed reproduction of submittals reviewed electronically, transmission errors or returned electronic submittals that become corrupted or are otherwise not accessible by the Contractor's or Subcontractor's computer hardware and/or software.

I. Product Data: Submit Manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications.

1. Steel Studs

2. Anchors and anchor bolts

3. Self drilling screws

J. Shop Drawings:

1. Shop Drawing Review: Electronic files of structural drawings **will not** be provided to the contractor for preparation of shop drawings. Reproduction of any portion of the Construction Documents for use as Shop drawings and/or Erection Drawings is prohibited. Shop drawings and/or Erection drawings created from reproduced Construction Documents will be returned without review.

2. General: Submit shop drawings showing the following:

    a. Stud gages and spacings.

    b. Sizes, gages and fastenings for all built-up members including but not limited to headers and jambs.

    c. Shop Coatings

    d. Type, size, quantity, locations and spacings of all anchorages and self drilling screws.

    e. Details of attachment to structure and adjacent work

    f. Supplemental strapping, bracing, splices, bridging, hat channels and other accessories required for proper installation.

    g. Critical installation procedures.

3. Conformance of the Shop Drawings to the Contract Drawings remains the responsibility of the General Contractor. Engineer's review in no way relieves the General Contractor of this responsibility.

4. Shop drawings will not be reviewed as partial submittals. A complete submittal shall be provided and shall include; erection and piece drawings. **Incomplete submittals will not be reviewed.**

K. Design calculations shall be prepared by a Professional Engineer (Specialty Engineer) registered in the State of Maine, illustrating the design of exterior steel stud wall systems including all all necessary stiffeners and bracing connections and anchorage required for a complete structural system.

L. The Specialty Engineer shall design the attachments of veneer and siding elements, such that pull out loads under wind or seismic loads will not be exceeded. Coordinate this design with other specification sections, including Unit Masonry and Precast Concrete.

M. Professional Engineer responsible for design of cold formed framing shall review the installation and submit a correspondence indicating compliance with the design. Review shall include all work. Any discrepancies noted shall be corrected and reviewed by the Engineer prior to the submittal of the correspondence.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Deliver materials to site at such intervals to insure uninterrupted progress of work.

B. Deliver anchorage devices, which are to be embedded in cast-in-place, in ample time to not delay work.

C. Store materials to permit easy access for inspection and identification. Keep cold formed members off ground, using pallets, platforms, or other supports. Protect cold formed members and packaged materials from corrosion and deterioration.

D. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Materials shall be stored in a manner to avoid ponding of precipitation on members. Repair or replace damaged materials or structures as directed.

PART 2 PRODUCTS

2.01 FRAMING MEMBERS

A. Steel Studs:

1. Acceptable manufacturers: Manufacturer shall be a member of the Steel Stud Manufacturers Association.

2. Minimum stud shall be 8”, 18 gage with 1.625” flange at siding.

3. Minimum stud shall be 8”, 16 gage with 2.0” flange at masonry veneer.

4. Maximum Spacing: 16 inches, on-center.

5. Minimum studs indicated have not been engineered, but are provided as a general guideline. Engineering of studs is the responsibility of the Specialty Design Engineer referenced in the Submittals Section, and not the Engineer of Record nor the Architect of Record. Any exterior stud size, gage, spacing, bracing and connection information shown on the Contract Documents is schematic only. The Contractor shall provide the studs and built-up sections, engineered by the Specialty Engineer. If studs of a thicker gage or lesser spacing are required by the Specialty Engineer's design, the studs shall be provided at no additional cost to the Owner.

6. Provide channel-shaped load-bearing studs, channel-shaped joists, runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, stiffeners, fasteners, and other accessories recommended by manufacturer for complete framing system

7. Steel framing materials shall comply with ASTM A 446, A 570, or A 611, as applicable. Fabricate all components from structural quality sheet steel with the following minimum yield points:

    a. 16 ga. and heavier 50,000 psi

    b. 18 ga., 33,000 psi

    c. 20 ga., 33,000 psi (permitted for bottom track only).

8. Manufacture of studs, runners (track), and other framing members shall comply with ASTM C 955.

9. Framing components shall be galvanized per ASTM A 525, minimum G-60 coating.

B. Screws and other attachment devices:

1. Provide a protective cadmium or zinc plated coating and comply with ASTM A 165 type NS.

2. Self-drilling screws shall comply with the Industrial Fastener Institute Standard for steel self-drilling and tapping screws (IFI-113).

3. Penetration through jointed materials shall not be less than three (3) exposed threads.

C. Standard Steel Shapes: Standard steel shapes, plates, etc. shall conform to material and finish specifications in Division 5 -Miscellaneous Metals.

PART 3 EXECUTION

3.01 INSTALLATION

A. Product Storage: Store studs, joists, track etc. on a flat plane. Material damaged (i.e. rusted, dented, bent or twisted) shall be discarded. Protect adhesives and sealants from freezing.

B. Construction Methods: Construction may be either piece-by-piece (stick-built), or by fabrication into panels either on or off site.

C. Material Fit up: All framing components shall be cut squarely or at an angle to fit squarely against abutting members. Members shall be held firmly in position until properly fastened. Prefabricated panels, if used, shall be square and braced against racking. Provide blocking and strapping within 12” of slip joint and at 8’-0” o.c., or as required for member bracing.

D. Attachment: Components shall be joined by self-drilling screws, so that connection meets or exceeds required design loads. Wire tying of framing components will not be permitted. Field welding will be permitted only where shown on the drawings.

E. Anchorage to Structure: Securely anchor studs and track to floor construction and overhead structure. Provide fasteners at a maximum of 16” on center. Provide slip joints where non-bearing vertical studs meet floor or roof structural steel, or as indicated on the drawings. Provide sill sealer beneath all floor tracks.

F. Welding: Shop and field welds shall conform to applicable AWS and AISI standards, and may be fillet, plug, butt or seam type. Touch-up damage to galvanizing caused by welding with zinc-rich paint.

G. Openings: Frame openings larger than 2 ft. square with double studs. Provide suitable reinforcements (double studs, headers, jack studs, cripples, bracing, etc.) at control joint intersections, corners, and other special conditions.

H. Lintels: Lintels supporting masonry veneer shall be secured to studs by screws or power-driven anchors. Method of anchorage shall be sufficient to support veneer with a factor of safety of 3.0.

I. Bridging/Bracing: Provide horizontal strap bracing for all walls. Minimum requirements are as follows: Horizontal bracing shall be continuous 20 gage x 1 1/2" wide steel straps on each face of the stud, located at 4'-0" maximum for the full height of the wall. Provide CR runner solid bridging at 8'-0" for the full height of the wall at each line of bracing. An additional row of bracing shall be provide within 12 inches of the slip joint.

J. Tolerances: Finished installation shall be level and plumb within a tolerance of 1/8 inch in 10 feet horizontally and vertically. Maximum deviation from plan or section dimension shall not exceed 1/8 inch. Spacing of studs shall not be more than 1/8 inch from design spacing, providing that cumulative error does not exceed requirements of finishing materials.

END OF SECTION

SECTION 05500 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Steel ladders.
2. Loose bearing and leveling plates.
3. Loose steel lintels.
4. Shelf angles.
5. Support angles for elevator door sills.
6. Elevator machine beams.
7. Steel framing and supports for countertops.
8. Steel framing and supports for mechanical and electrical equipment.
9. Steel framing and supports for applications where framing and supports are not specified in other Sections.
10. Loading-dock edge angles.
11. Miscellaneous metal trim.
12. Pipe bollards.

B. Related Sections include the following:

1. Division 5 Section "Structural Steel" for structural-steel framing system components.
2. Division 5 Section "Metal Stairs" for metal-framed stairs with metal pan, metal plate, or grating treads.
3. Division 5 Section "Pipe and Tube Railings" for metal pipe and tube handrails and railings.
4. Division 6 Section "Rough Carpentry" for metal framing anchors and other rough hardware. Delete subparagraph above and below if pit ladders are in this Section.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Paint products.
3. Grout.

B. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1. Provide templates for anchors and bolts specified for installation under other Sections.

C. Samples for Verification: For each type and finish of extruded nosing and tread.

D. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

E. Welding Certificates: Copies of certificates for welding procedures and personnel.

F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
4. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 PROJECT CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

1.6 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor

bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.

C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

D. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.

E. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

F. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

G. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.3 ALUMINUM

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy 6063-T6.

B. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, alloy 6061-T6.

2.4 PAINT

A. Shop Primers: Provide primers that comply with Division 9 Section "Painting."

B. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

C. Shop Primer for Ferrous Metal: Organic zinc-rich primer, complying with SSPC-Paint 20 and compatible with topcoat.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Carboline 621; Carboline Company.
b. Aquapon Zinc-Rich Primer 97-670; PPG Industries, Inc.
c. Tneme-Zinc 90-97; Tnemec Company, Inc.

D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

E. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FASTENERS

A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36.

D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. Wood Screws: Flat head, carbon steel, ASME B18.6.1.

G. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).

H. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).

I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

2. Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M).

J. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

2.6 GROUT

A. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.

2.7 CONCRETE FILL

A. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa), unless otherwise indicated.

2.8 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Shear and punch metals cleanly and accurately. Remove burrs.

C. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

H. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

J. Remove sharp or rough areas on exposed traffic surfaces.

K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.9 STEEL LADDERS

A. General: Fabricate ladders for locations shown, with dimensions, spacings, details, and anchorages as indicated.

1. Comply with ANSI A14.3, unless otherwise indicated.
2. For elevator pit ladders, comply with ASME A17.1.

B. Siderails: Continuous, 3/8-by-2-1/2-inch (10-by-64-mm) steel flat bars, with eased edges, spaced 16 inches (406 mm) apart.

C. Bar Rungs: 3/4-inch- (19-mm-) diameter steel bars, spaced 12 inches (300 mm) o.c.

D. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.

E. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.

F. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.

G. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung by a proprietary process.

H. Galvanize ladders, including brackets and fasteners, in the following locations:
1. Interior, where there are moist conditions.

2.10 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates after fabrication.

2.11 LOOSE STEEL LINTELS

A. Fabricate loose structural-steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

B. Weld adjoining members together to form a single unit where indicated.

C. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm), unless otherwise indicated.

D. Galvanize loose steel lintels located in exterior walls.

2.12 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete. Align expansion joints in angles with indicated control and expansion joints in cavity-wall exterior wythe.

C. Galvanize shelf angles to be installed in exterior walls.

D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.13 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.

B. General: Provide steel framing and supports indicated and as necessary to complete the Work.

C. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Fabricate units from slotted channel framing where indicated.
2. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long at 24 inches (600 mm) o.c., unless otherwise indicated.
3. Furnish inserts if units must be installed after concrete is placed.

D. Fabricate supports for operable partitions as follows:

1. Beams: Continuous steel shapes of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

E. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.

1. Provide bearing plates welded to beams where indicated.
2. Drill girders and plates for field-bolted connections where indicated.
3. Where wood nailers are attached to girders with bolts or lag screws, drill holes at 24 inches (600 mm) o.c.

F. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness, unless otherwise indicated.

1. Unless otherwise indicated, provide 1/2-inch (12-mm) baseplates with four 5/8-inch (16-mm) anchor bolts and 1/4-inch (6-mm) top plates.

G. Galvanize miscellaneous framing and supports where indicated.

2.14 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from structural-steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches (150 mm) from each end, 6 inches (150 mm) from corners, and 24 inches (600 mm) o.c., unless otherwise indicated.

C. Galvanize miscellaneous steel trim in the following locations:

1. Exterior.
2. Interior, where indicated.

2.15 PIPE BOLLARDS

A. Fabricate pipe bollards from Schedule 80 steel pipe.

1. Cap bollards with 1/4-inch- (6-mm-) minimum steel plate.

B. Fabricate bollards with 3/8-inch- (10-mm-) thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch (19-mm) anchor bolts.

1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

C. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch (6-mm) thick steel plate welded to bottom of sleeve.

D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch (6-mm) wall-thickness steel tubing with an OD 1/16 inch (1.5 mm) less than ID of bollards. Match drill sleeve and bollard for 1/2-inch (12-mm) steel machine bolt.

2.16 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.17 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.18 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 SETTING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated at girders supported on concrete or masonry, install as specified above for setting and grouting bearing and leveling plates.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified above for setting and grouting bearing and leveling plates.

1. Do not grout baseplates of columns supporting steel girders until girders are installed and leveled.

3.4 INSTALLING PIPE BOLLARDS

A. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. After bollards have been inserted into sleeves, fill annular space between bollard and sleeve solidly with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.

B. Anchor bollards in concrete in formed or core-drilled holes not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) greater than OD of bollard. After bollards have been inserted into holes, fill annular space surrounding bollard solidly with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.

C. Anchor bollards in place with concrete footings. Support and brace bollards in position in footing excavations until concrete has been placed and cured.

D. Anchor bollards to existing construction with postinstalled anchors and bolts. Provide four 3/4-inch (19-mm) anchors at each bollard, unless otherwise indicated. Embed anchors at least 4 inches (100 mm) in existing concrete.

E. Anchor internal sleeves for removable bollards in concrete by inserting into pipe sleeves preset into concrete. After internal sleeves have been inserted, fill annular space between sleeves solidly with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward internal sleeve.

F. Anchor internal sleeves for removable bollards in formed or core-drilled holes not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) greater than OD of sleeve. After sleeves have been inserted into holes, fill annular space surrounding sleeves solidly with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward sleeve.

G. Anchor internal sleeves for removable bollards in place with concrete footings. Support and brace sleeves in position in footing excavations until concrete has been placed and cured.

1. Place removable bollards over internal sleeves and secure with 1/2-inch (12-mm) machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner will furnish padlocks.

H. Fill bollards solidly with concrete, mounding top surface.

1. Do not fill removable bollards with concrete.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 Section "Painting."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05500

SECTION 055100 - METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Preassembled steel stairs with concrete-filled treads.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
2. Division 05 Section "Metal Fabrications" for metal treads and nosings not installed in metal stairs.
3. Division 05 Section "Pipe and Tube Railings" for pipe and tube railings.
4. Division 06 Section "Rough Carpentry" for wood blocking for anchoring railings.
5. Division 09 Section "Gypsum Board" for metal backing for anchoring railings.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance of Stairs: Provide metal stairs capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch (6.4 mm), whichever is less.

1.4 SUBMITTALS

A. Product Data: For metal stairs and the following:

1. Prefilled metal-pan stair treads.
2. Paint products.
3. Grout.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Provide templates for anchors and bolts specified for installation under other Sections.
2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

1. Preassembled Stairs: Commercial class.

C. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.6 COORDINATION

A. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.3 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500 (cold formed).

C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

D. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

E. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

F. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

2.4 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36.

D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

G. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

H. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Division 09 painting Sections.

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Available Products:
   a. ICI Devoe Coatings; Catha-Coat 313.
   b. Moore, Benjamin, & Co.; Epoxy Zinc-Rich Primer CM18/19.
   c. Sherwin-Williams Company (The); Corothane I GalvaPac Zinc Primer.

E. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

H. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa), unless otherwise indicated.

2.6 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts,[**railings,**] clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding, unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.
3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously, unless otherwise indicated.
5. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.7 STEEL-FRAMED STAIRS

A. Available Manufacturers:

1. Alfab, Inc.
2. American Stair, Inc.
3. Sharon Companies Ltd. (The).

B. Stair Framing:

1. Fabricate stringers of steel channels.

a. Provide closures for exposed ends of channel stringers.

2. Construct platforms of steel channel headers and miscellaneous framing members as needed to comply with performance requirements.
3. Weld or bolt stringers to headers; weld framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.

4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.0677 inch (1.7 mm).

1. Steel Sheet: Uncoated hot-rolled steel sheet**,** unless otherwise indicated.
2. Steel Sheet: Galvanized steel sheet**,** in damp areas.
3. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
5. Shape metal pans to include nosing integral with riser.
6. At Contractor's option, provide stair assemblies with metal-pan subtreads filled with reinforced concrete during fabrication.
7. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

    a. Smooth Soffit Construction: Construct subplatforms with smooth soffits.

2.8 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal stairs after assembly.

C. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123/A 123M, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
3. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:
1. Interior Stairs (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

E. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete, unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.2 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.

B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonmetallic, nonshrink grout, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055100

SECTION 05521 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Stainless-steel pipe and tube handrails and railings.
   2. Steel pipe and tube handrails and railings.

B. Related Sections include the following:

   1. Division 5 Section "Metal Stairs" for steel pipe handrails and railings included with metal

1.3 PERFORMANCE REQUIREMENTS

A. General: In engineering handrails and railings to withstand structural loads indicated, determine allowable design working stresses of handrail and railing materials based on the following:

   1. Aluminum: AA 30, "Specifications for Aluminum Structures."
   2. Stainless Steel: ASCE 8, "Specification for the Design of Cold-Formed Stainless Steel Structural Members."
   3. Structural Steel: AISC S335, "Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary."
   4. Cold-Formed Structural Steel: AISI SG-673, Part I, "Specification for the Design of Cold-Formed Steel Structural Members."

B. Structural Performance of Handrails and Railings: Provide handrails and railings complying with requirements of ASTM E 985 for structural performance, based on testing performed according to ASTM E 894 and ASTM E 935.

C. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding the following structural loads without exceeding allowable design working stresses of materials for handrails, railings, anchors, and connections:

   1. Top Rail of Guards: Capable of withstanding the following loads applied as indicated:

      a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
      b. Uniform load of 50 lbf/ft. (730 N/m) applied horizontally and concurrently with uniform load of 100 lbf/ft. (1460 N/m) applied vertically downward.
      c. Concentrated and uniform loads above need not be assumed to act concurrently.

2. Handrails Not Serving As Top Rails: Capable of withstanding the following loads applied as indicated:

   a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
   b. Uniform load of 50 lbf/ft. (730 N/m) applied in any direction.
   c. Concentrated and uniform loads above need not be assumed to act concurrently.

3. Infill Area of Guards: Capable of withstanding a horizontal concentrated load of 200 lbf (890 N) applied to 1 sq. ft. (0.09 sq. m) at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.

   a. Load above need not be assumed to act concurrently with loads on top rails in determining stress on guard.

D. Thermal Movements: Provide handrails and railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected handrails and railings.
2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Show fabrication and installation of handrails and railings. Include plans, elevations, sections, component details, and attachments to other Work.

1. For installed handrails and railings indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for products with factory-applied color finishes.

D. Samples for Initial Selection: Short sections of railing or flat, sheet metal samples showing available mechanical finishes.

E. Samples for Verification: For each type of exposed finish required, prepared on components indicated below and of same thickness and metal indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1. 6-inch- (150-mm-) long sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Assembled sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Sample need not be full height.

F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

G. Product Test Reports: From a qualified testing agency indicating products comply with requirements, based on comprehensive testing of current products.

H. Product Test Reports: From a qualified testing agency indicating handrails and railings comply with ASTM E 985, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of handrails and railings that are similar to those indicated for this Project in material, design, and extent.

B. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

C. Source Limitations: Obtain each type of handrail and railing through one source from a single manufacturer.

1.6 STORAGE

A. Store handrails and railings in a dry, well-ventilated, weathertight place.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify handrail and railing dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating handrails and railings without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate installation of anchorages for handrails and railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.9 SCHEDULING

A. Schedule installation so handrails and railings are mounted only on completed walls. Do not support temporarily by any means that does not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Stainless-Steel Pipe and Tube Railings:

a. Alumaguard.
b. Architectural Art Mfg., Inc.
c. Blum: Julius Blum & Co., Inc.
d. CraneVeyor Corp.
e. KDI Paragon, Inc.
f. Stainless Fabricators, Inc.
g. Wagner: R & B Wagner, Inc.

2. Steel Pipe and Tube Railings:

a. Humane Equipment Co.
b. Wagner: R & B Wagner, Inc.

2.2 METALS

A. General: Provide metal free from pitting, seam marks, roller marks, stains, discolorations, and other imperfections where exposed to view on finished units.

B. Stainless Steel: Grade or type designated below for each form required:

1. Tubing: ASTM A 554, Grade MT 304.
2. Pipe: ASTM A 312/A 312M, Grade TP 304.
3. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.
4. Plate: ASTM A 666, Type 304.

C. Steel and Iron: Provide steel and iron in the form indicated, complying with the following requirements:

1. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:

    a. Black finish, unless otherwise indicated.
    b. Galvanized finish for exterior installations and where indicated.
    c. Type F, or Type S, Grade A, standard weight (Schedule 40), unless another grade and weight are required by structural loads.

2. Steel Tubing: Cold-formed steel tubing, ASTM A 500, Grade A, unless another grade is required by structural loads.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.3 WELDING MATERIALS, FASTENERS, AND ANCHORS

A. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Fasteners for Anchoring Handrails and Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring handrails and railings to other types of construction indicated and capable of withstanding design loads.
1. For stainless-steel handrails and railings, use fasteners fabricated from Type 304 or Type 316 stainless steel.
2. For steel handrails, railings, and fittings, use plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.

C. Fasteners for Interconnecting Handrail and Railing Components: Use fasteners fabricated from same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

1. Provide concealed fasteners for interconnecting handrail and railing components and for attaching them to other work, unless otherwise indicated.
2. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

D. Cast-in-Place and Postinstalled Anchors: Anchors of type indicated below, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Cast-in-place anchors.
2. Chemical anchors.
3. Expansion anchors.

2.4 PAINT

A. Shop Primers: Provide primers to comply with applicable requirements in Division 9 Section "Painting."

B. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

C. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated, and complying with SSPC-Paint 5.

D. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

B. Interior Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Use for interior applications only.

C. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. General: Fabricate handrails and railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble handrails and railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Form changes in direction of railing members as follows:

1. As detailed.
2. By bending.
3. By mitering at elbow bends.
4. By inserting prefabricated flush-elbow fittings.
5. By any method indicated above, applicable to change in direction involved.

D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

E. Welded Connections: Fabricate handrails and railings for connecting members by welding. Cope components at perpendicular and skew connections to provide close fit, or use fittings designed for this purpose. Weld connections continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

F. Nonwelded Connections: Fabricate handrails and railings by connecting members with concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive where this is manufacturer's standard splicing method.

G. Welded Connections for Aluminum Pipe: Fabricate pipe handrails and railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work, unless otherwise indicated.

I. Provide inserts and other anchorage devices for connecting handrails and railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.

J. For railing posts set in concrete, provide preset sleeves of steel not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (12 mm) greater than outside dimensions of post, and steel plate forming bottom closure.

K. For removable railing posts, fabricate slip-fit sockets from steel tube whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

L. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

M. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

N. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.

O. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.

P. Fabricate joints that will be exposed to weather in a watertight manner.

Q. Close exposed ends of handrail and railing members with prefabricated end fittings.

R. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of railing and wall is 1/4 inch (6 mm) or less.

S. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

T. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of handrails and railings.

2.8 STAINLESS-STEEL FINISHES

A. Remove or blend tool and die marks and stretch lines into finish.

B. Grind and polish surfaces to produce uniform, directionally textured polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. 180-Grit Polished Finish: Oil-ground, uniform, textured finish.

D. 320-Grit Polished Finish: Oil-ground, uniform, smooth finish.

E. Polished and Buffed Finish: Oil-ground, 180-grit finish followed by buffing.

F. Bright, Directional Polish: No. 4 finish.

G. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.9 STEEL FINISHES

A. Galvanized Handrails and Railings: Hot-dip galvanize exterior steel and iron handrails and railings to comply with ASTM A 123. Hot-dip galvanize hardware for exterior steel and iron handrails and railings to comply with ASTM A 153/A 153M.

B. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. For galvanized handrails and railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

D. For nongalvanized steel handrails and railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

E. Preparation for Shop Priming: After galvanizing, thoroughly clean handrails and railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate process.

F. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed handrails and railings:

1. Exteriors (SSPC Zone 1B): SSPC-SP 6, "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 7, "Brush-off Blast Cleaning."

G. Apply shop primer to prepared surfaces of handrail and railing components, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Do not apply primer to galvanized surfaces.
2. Stripe paint edges, corners, crevices, bolts, and welds.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required to install handrails and railings. Set handrails and railings accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.

1. Do not weld, cut, or abrade surfaces of handrail and railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

D. Adjust handrails and railings before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing handrails and railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of handrails and railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with the following

anchoring material, mixed and placed to comply with anchoring material manufacturer's written instructions:

B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's written instructions:

1. Nonshrink, nonmetallic grout.
2. Nonshrink, nonmetallic grout or anchoring cement.

C. Cover anchorage joint with flange of same metal as post, attached to post as follows:

1. Welded to post after placing anchoring material.
2. By set screws.

D. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8-inch (3-mm) build-up, sloped away from post.

E. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
1. For stainless-steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
2. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ANCHORING RAILING ENDS

A. Anchor railing ends into concrete and masonry with round flanges connected to railing ends and anchored into wall construction with postinstalled anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces.

1. Weld flanges to railing ends.
2. Connect flanges to railing ends using nonwelded connections.

3.6 ATTACHING HANDRAILS TO WALLS

A. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface.

B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.

3. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed gypsum board assemblies, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.

3.7 CLEANING

A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 Section "Painting."

D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.8 PROTECTION

A. Protect finishes of handrails and railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05521

SECTION 057300 – ORNAMENTAL METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes interior railing system.

1.3 INTERIOR RAILING SYSTEM

A. Design Basis: Optik Railings as manufactured by HDI Railing Systems, www.handrail-design.com.

1. Configuration and Height: As indicated on the Drawings.

B. Other Acceptable Products:

1. View Glass Railing System by Viva Architectural Hardware: www.vivahardware.com.
2. Structural Glazing System by Mogg Constructive Inc.: www.mogg.ca.
3. RS0B2134BS standoff bases and caps; HR2EGBS railing brackets by C.R. Laurence Co., Inc.: www.crlaurence.com.

C. Material: Stainless steel; AISI type 304; surface preparation #6 (240 grain) flat finish.

D. Handrail: 1-1/2 inch (38 mm) outside diameter tubes with 5/64 inch (2 mm) wall thickness.

E. Panel Mounting Bosses: Stainless steel; sized to fit glazed panel thickness.

F. Fasteners: Stainless steel; size and type as determined by engineering and systems structural performance requirements. Embed in Concrete or Masonry: Capable of resisting, without failure, load imposed within a safety factor of 4, when tested in accordance with ASTM E 488.

1.4 GLASS AND GLAZING MATERIALS

A. Glass: Tempered glass, 1/2” thick; polished edges; Dubbed (blunt) corners.

B. Manufacture tempered glass by horizontal (roller hearth) process.

1.5 FABRICATION

A. Fabricate railing system for compliance with structural requirements of applicable codes and applicable requirements of ASTM E 985.

B. Pre-assemble railings prior to shipping to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and for coordination with Shop Drawings.

C. Make tubing cuts square, without burrs and, where exposed, rounded to produce smooth, rigid and hairline joints.

END OF SECTION 057300

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Framing with dimension lumber.
2. Rooftop equipment bases and support curbs.
3. Wood blocking, and nailers.
4. Wood furring.
5. Wood sleepers.
6. Utility shelving.
7. Plywood backing panels.

1.3 DEFINITIONS

A. Exposed Framing: Framing not concealed by other construction.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.

C. Timber: Lumber of 5 inches nominal (114 mm actual) or greater in least dimension.

D. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. RIS: Redwood Inspection Service.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.4 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments specified to be High-Temperature (HT) type, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

C. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

D. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Power-driven fasteners.
5. Powder-actuated fasteners.
6. Expansion anchors.
7. Metal framing anchors.

1.5 QUALITY ASSURANCE

A. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish.
3. In DOC PS 20, dressed sizes of green lumber are larger than dry lumber.
4. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
5. Provide dressed lumber, S4S, unless otherwise indicated.

B. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. General: Comply with performance requirements in.

B. Exterior type is suitable for both exterior and interior applications. Interior type is only for interior applications. See Evaluations.

1. Use Exterior type for exterior locations and where indicated.
2. Use Interior Type A, High Temperature (HT) for enclosed roof framing, framing in attic spaces, and where indicated.
3. Use Interior Type A, unless otherwise indicated.

C. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

1. For exposed lumber indicated to receive a stained or natural finish.

D. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

E. Application: Treat

1. Framing for raised platforms.

2. Concealed blocking.
3. Framing for non-load-bearing partitions.
4. Framing for non-load-bearing exterior walls.
5. Roof construction.
6. Plywood backing panels, as required by code

2.3 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.
7. Utility shelving.

B. For items of dimension lumber size, provide grade lumber with percent maximum moisture content of any species.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged,[**fire-retardant treated,**] in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners[**with hot-dip zinc coating complying with ASTM A 153/A 153M**] [**of Type 304 stainless steel**].

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.6 METAL FRAMING ANCHORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Products: Subject to compliance with requirements, provide or comparable products by one of the following:

1. Alpine Engineered Products, Inc.
2. Cleveland Steel Specialty Co.
3. Harlen Metal Products, Inc.
4. KC Metals Products, Inc.
5. Simpson Strong-Tie Co., Inc.
6. Southeastern Metals Manufacturing Co., Inc.
7. USP Structural Connectors.

D. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those [**of basis-of-design products**]. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

E. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

1. Use for interior locations where stainless steel is not indicated.

F. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.

1. Width: [**3/4 inch (19 mm)**].
2. Thickness: [**0.050 inch (1.3 mm)**].
3. Length: [**As indicated**].

G. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches (38 mm) wide by 0.050 inch (1.3 mm) thick.[**Tie fastens to side of rafter or truss, face of top plates, and side of stud below.**]

2.7 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.

B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

C. Adhesives for Gluing to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

1. Use adhesives that have a VOC content of g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

D. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.

E. Do not splice structural members between supports, unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- (38-mm actual-) thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.

H. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's Uniform Building Code.
4. Table 2305.2, "Fastening Schedule," in BOCA's BOCA National Building Code.
5. Table 2306.1, "Fastening Schedule," in SBCCI's Standard Building Code.
6. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
7. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's International One- and Two-Family Dwelling Code.

K. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials.

Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.2 WOOD, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- (19-by-63-mm actual-) size furring at o.c.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 06 19 00 – METAL PLATE CONNECTED PRE-FABRICATED WOOD TRUSSES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. The drawings and general conditions of the contract including General and Supplementary Conditions and other Division 1 Specification sections apply to work of this section.

B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK:

A. Definition: Prefabricated wood trusses include planar structural units consisting of metal plate connected members which are fabricated from dimension lumber and which have been cut and assembled prior to delivery to the job site. Work to include anchorage, blocking, curbing, miscellaneous framing and bracing.

B. Types of fabricated wood trusses are indicated on the drawings.

1.03 RELATED WORK SPECIFIED ELSEWHERE:

A. Section 06 10 00 - Rough Carpentry

1.04 QUALITY ASSURANCE:

A. TPI Standards: Comply with applicable requirements and recommendations of the following Truss Plate Institute (TPI) publications, Latest Edition:

1. ANSI/TPI 1 “National Design Standard for Construction. Metal Plate Connected Wood Truss.”

2. ANSI/AF&PA (American Forest & Paper Association) – NDS National Design Specification for Wood Construction – Latest Edition

3. “Commentary and Appendices to ANSI/TPI 1 for Bracing Wood Trusses.”

4. “Building Component Safety Information, BCSI 1”

5. DSB-89 “Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses.”

6. “Quality Assurance Procedures Manual for In-Plant Inspections, QAP-90.”

7. “Quality Control Manual.”

8. “Code of Federal Regulations, Part 1926” per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).

B. Wood Structural Design Standard: Comply with applicable requirements of "National Design Specification for Wood Construction", published by American Forest and Paper Association.

C. Lumber Standard: Comply with PS 20 and with applicable rules of the respective grading inspecting agencies for species and grade of lumber indicated.

D. Connector Plate Manufacturer's Qualifications: Provide truss connector plates manufactured by a firm which is a member of TPI and which complies with TPI quality control procedures for manufacture of connector plates published in TPI "Quality Control Manual."

E. Fabricator's Qualifications:

1. Provide trusses by a firm which has a record of successfully fabricating trusses similar to type and length indicated.

2. TPI Inspection Program: Fabricator shall participate in the TPI Quality Assurance Inspection Program, and maintain a copy of the Quality Assurance Procedures Manual, QAP-90. All trusses fabricated for this project shall bear the TPI Registered Mark to indicate compliance with this program.

F. Uniformity of Manufacturer for Connector Plates: Provide metal connector plates form a single manufacturer.

1.05 SUBMITTALS:

A. Unless otherwise specified, submittals required in this section shall be submitted for review. Submittals shall be prepared and submitted in accordance with Division 1.

B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner's Notice to Proceed.

C. All submittals shall be reviewed and returned to the Architect within 10 working days.

D. Incomplete submittals will not be reviewed.

E. Submittals not review by the General Contractor prior to submission the Engineer will not be reviewed. Include on the submittal a statement or stamp of approval by the Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in sections Division 1 have been complied with.

F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.

G. **Truss design calculations without the appropriate signature and seal indicated below will be rejected and returned without review.**

H. Hardcopy Submittals: Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.

I. Electronic Submittals:

1. Contractor shall include in the submittal schedule an indication of submittals that are intended to be submitted electronically. Upon receipt of the submittal schedule, the Engineer reserves the right to indicate submittals that will not be accepted electronically. Paper copies of such submittals shall be furnished as referenced in this specification.

2. The Engineer reserves the right to require paper copies of submittals that are received electronically. Provide Engineer one (1) paper copies in addition to the electronic submittal. Paper copy will be retained and electronic copy will be returned. Review cycle for such submittals shall not commence until such time that the paper copies are received.

3. Electronic Submittals shall be submitted in Protected Document Format (PDF) compatible with Adobe Acrobat Professional version 7.0 or later. Electronic files shall not be broken into smaller individual files. File sizes too large to process email or within a file transfer protocol (FTP) site shall be provided on a CD.

4. The submission of submittals electronically does not relieve the contractor of their responsibility to review the submittal prior to transmission to the Engineer. Electronic Submittals shall include contractor comments, and a statement and/or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with. Electronic submittals without the Contractor's approval will be rejected and returned.

5. The Engineer assumes no responsibility for the printed reproduction of submittals reviewed electronically, transmission errors or returned electronic submittals that become corrupted or are otherwise not accessible by the Contractor's or Subcontractor's computer hardware and/or software.

J. Product Data: Submit fabricator's technical data covering lumber, metal plates, hardware, fabrication process, treatment (if any), handling and erection.

1. Submit certificate, signed by an officer of fabricating firm, indicating that trusses to be supplied for project comply with indicated requirements.

2. Submit evidence of participation in the TPI Inspection program.

K. Shop Drawings: Submit shop drawings, showing species, sizes and stress grade of lumber to be used; pitch, span, camber, configuration and spacing for each type of truss required; type size, material, finish, design value and location of metal connector plates; and bearing and anchorage details.

1. Electronic files of structural drawings **will not** be provided to the contractor for preparation of shop drawings. Reproduction of any portion of the Construction Documents for use as Shop drawings and/or Erection Drawings is prohibited. Shop drawings and/or Erection drawings created from reproduced Construction Documents will be returned without review.

2. **Conformance of the Shop Drawings to the Contract Drawings remains the responsibility of the General Contractor. Engineer's review in no way relieves the General Contractor of this responsibility. Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be**

returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.

3. Truss Placement Plan: Provide drawings indicating truss layout.

    a. Include all trusses and components, including girder trusses, piggyback trusses, and hangers.

    b. Provided dimensions for layout, including bearing locations & widths, and truss spacing

4. Design: Design shall be in accordance with the applicable provisions of the latest edition of the American Forest & Paper Association's (AF&PA's) National Design Specification for Wood Construction, ANSI/TPI 1, and all applicable legal requirements. Submit the following information in the calculation submittal for each truss or truss component. Calculations are to be prepared under the direct supervision of a Professional Engineer Registered in the State of Maine. Calculations shall be signed and sealed by a Professional Engineer Registered in the State of Maine. Truss designer is responsible for the design of the entire truss assembly, including permanent lateral bracing. Lateral loads shall be resolved into the building lateral load resisting system.

    a. Loading: Include all loadings applied to the truss, including uniform, concentrated loads and locations. Include effects of mechanical equipment, drifted and unbalanced snow. Indicate distribution of loads to top and bottom chords. The calculations shall clearly show these loads and their application to the trusses.

    b. Wind & Seismic Loading Criteria: Include all appropriate information wind & seismic loading criteria. Including design code, wind speed and exposure. Design code and wind speed shall be as indicated in the drawings.
        1. Provide uplift calculations and truss uplift reactions as appropriate.

        2. Design gable end trusses for wind and seismic loads. Vertical members in gable end trusses shall be at 16" o.c. maximum. End wall horizontal deflections shall not exceed L/240 where supporting siding or **L/600 where supporting brick veneer.** Provide ganged trusses, strong backed studs or adequate bracing as required to provide a complete end wall system.

c. Load Combinations: The calculations shall list all load combinations including all factors that apply.

d. Adjustments to lumber and metal connector plate design values for conditions of use. Adjustment of value for duration of load or conditions of use shall be in accordance with AF&PA's National Design Specification for Wood Construction.

e. Truss-to-Truss Connections: Provide hanger designs where applicable. Provide design of connectors in multi-ply trusses. Provide connection design for piggyback trusses.

f. Stress and Deflection calculations: Provide member stresses and joint displacement for each load and load combination, and displacement to span ratio. Indicate camber independently from displacement calculations. Provide bearing stresses at supports.

   Vertical Deflection Limits: Design trusses to limit deflection under design live or snow loads to L/240 for roof trusses.

g. Reaction: Provide minimum and maximum reactions, including uplift as applicable. Indicate the load combination that produces these reactions.

h. Girder truss bearing stress limitation: Bearing stress values at girder trusses shall be no greater than the values indicated below. Truss manufacturer shall provide additional truss plies, truss bearing enhancement devices or additional material as necessary to meet this requirement.

   1.05.K.4.h.1 Girder trusses bearing stress maximum limit, unless noted otherwise: 425 psi

   1.05.K.4.h.2 Girder truss bearing limit for truss bearing on Southern Yellow Pine material: 565 psi

i. Net Section at Hanger Connections: Design shall account for the net section loss to truss members from hung mechanical, electrical, plumbing and fire protection systems. General contractor shall coordinate hanger systems with the truss designer. Hanger systems are not designed by the Engineer of Record. See the "Execution" portion of this specification for additional requirements.

5. Field built trusses: To the greatest extent possible, trusses are to be prefabricated. Truss field fabrication is subject to the approval of the Structural Engineer. Additional design, quality assurance and quality control procedures may be necessary based on the requirements of the Structural Engineer.

6. Truss Assembly Drawings: Provide drawings depicting how each truss is to be constructed. Provide all geometry, including length, height, joint locations, slope, camber, overhangs, metal plate connectors, and lumber grades

7. Permanent Member Bracing: The truss manufacturer shall specify all permanent bracing required for lateral support of tension and compression members, both webs and chords. Gable end wall bracing shall also be specified. Permanent bracing loads shall be resolved to the building lateral load resisting system.

8. With all copies of drawing submittal provide "BCSI 1 (latest edition) Guide to Good practice for Handling, Installing & Bracing of Metal Plate Wood Trusses", Jointly produced by the Wood Truss Council of America and the Truss Plate Institute.

1.06 DELIVERY, STORAGE, HANDLING:

A. Handle and store trusses with care, and in accordance with manufacturer's instructions and TPI recommendations to avoid damage from bending, overturning or other cause for which truss is not designed to resist or endure.

B. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying work of other trades whose work must follow erection of trusses.

C. A copy of the BCSI (latest edition) Summary Sheet, "Guide for Handling, Installing and Bracing of Metal Plate Connected Wood Trusses" shall be provided to the installer at delivery.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering metal connector plates which may be incorporated in the work include, but are not limited to, the following:

Gang Nail Systems, Inc.
Hydro-Air Engineering, Inc.

Inter-Lock Steel Co., Inc.
Link-Wood Construction Systems
Robbins Manufacturing Co.
Tee-Lok Corp.
Truss Connectors of America
Truswall Systems Corp.

2.02 MATERIALS:

A. Lumber:

1. Factory mark each plate of lumber with type, grade, mill and grading agency.

2. Provide actual sizes as required by PS 20 for dressed limber, S4S, unless otherwise indicated. Minimum member sizes (nominal) are as follows:

   a. Chord members: 2x4 U.N.O.

   b. Web members: 2x4

3. Provide seasoned lumber with a maximum moisture content of 19% at time of dressing, and the moisture content of lumber shall be no less than 7% at time of manufacturing.

4. Lumber Species: Eastern Woods (Spruce) graded by NLGA, NELMA or NHPMA. Southern Pine graded by SPIB. Douglass Fir Larch graded by NLGA.

5. Lumber Grade:

   a. Chord Members: MSR 1650f-1.5E lumber for all chords.

   b. Web Members: No. 2 or better visually graded lumber for all webs. MSR lumber is acceptable in lieu of visually graded lumber for web members.

6. Stress Rating: Provide lumber which has been either graded or tested and certified, at indicated moisture content, to have the following minimum values:

   a. MSR: Fb = 1650 psi, Ft = 1020 psi, Fc = 1700 psi, E = 1,500,000 psi

   b. No.2: Fb = 875 psi, Ft = 450 psi, Fc = 1150 psi, E = 1,400,000 psi

7. Pressure treated lumber shall not be used.

B. Metal Connector Plates, Fasteners and Anchorages:

1. Connector Plate Material: Metal complying with following requirements, unless otherwise indicated: Not less that 0.036" thick, coated thickness, and shall meet or exceed ASTM A653/ASTMA653M grade 33. Working stresses in steel are to be applied to effectiveness ratios for plates as determined by test and in accordance with ANSI/TPI 1.

a. Galvanized Sheet Steel: ASTM A924/924M, Coating G60.

b. Electrolytic Zinc Coated Steel Sheet: ASTM A 591, Coating Class C, with minimum structural quality equivalent to ASTM A 446, Grade A.

C. Hangers and Uplift Anchors: Hangers are to be designed and supplied as part of the truss package, and shall be manufactured by Simpson StrongTie. Preliminary uplift anchors are indicated on the Contract Documents. Final uplift connector type and/or quantity will be selected based on truss reactions. G.C. coordinate with engineer's marks on approved truss shop drawings.

2.03 FABRICATION:

A. Trusses shall be fabricated to meet the quality requirements of ANSI/TPI 1.

B. Cut truss members to accurate lengths, angles and sizes to produce close fitting joints with wood-to-wood bearing in assembled units.

C. Fabricate metal connector plates to size, configuration, thickness and anchorage details required for types of joint designs indicated.

D. Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with close fitting joints. Position members to produce design camber indicated.

E. Connect truss members by means of metal connector plates accurately located and securely fastened to wood members by means indicated or approved.

F. Permanent web member bracing locations shall be marked on the truss members by means of a paint mark or tag of contrasting color. Tags shall not be removed without the permission of the Engineer.

G. All trusses shall bear the TPI Registered Mark, The TPI Quality Stamp, indicating current participation with the in-plant inspection program per the standards established in QAP-90.

PART 3 EXECUTION

3.01 GENERAL:

Erect and brace trusses to comply with recommendations of manufacturer and the Truss Plate Institute. Erection shall comply with current Occupational Safety & Health Administration (OSHA) requirements.

A. Inspect trusses for damage prior to erection. Apparent damage to trusses, if any, shall be reported to Truss Manufacturer prior to erection.

B. Truss Submittals and any supplementary information provided by the Truss Manufacturer shall be provided by the Contractor to the individual or organization responsible for the installation of the Trusses.

C. Erect trusses with plane of truss webs vertical (plumb) and parallel to each other, located accurately at design spacing indicated. Where applicable, insure bearing wall studs and trusses are aligned. The maximum out-of-true plumb tolerance shall be the depth of the truss in inches divided by 100. The maximum bow tolerance from true straight shall be the length of the truss in inches divided by 400, at any point considering multiple curvature when applicable.

D. Hoist units in place by means of lifting equipment suited to sizes and types of trusses required, applied at designated lift points as recommended by fabricator, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

E. Provide temporary bracing as required to maintain trusses plumb, parallel and in location indicated. Temporary bracing during construction is the responsibility of the contractor and the installer, as part of the contractor's "Means and Methods". TEMPORARY BRACING MUST BE PROVIDED IN THREE DIFFERENT PLANES OF THE TRUSS. BRACING SHALL BE INSTALLED ALONG THE BOTTOM CHORD, ALONG THE TOP CHORD AND WITHIN THE WEB MEMBERS. CONTRACTOR SHALL FOLLOW THE RECOMMENDATIONS OF SUMMARY SHEETS BCSI-

B1/B2 FOR HANDLING, INSTALLING AND BRACING METAL CONNECTED WOOD TRUSSES. TEMPORARY BRACING SHALL BE LEFT IN PLACE AND BECOME PART OF THE PERMANENT BRACING. MAXIMUM BRACE SPACINGS INDICATED IN BCSI SHALL NOT BE EXCEEDED.

F. Modifications required to the temporary bracing to comply with permanent bracing requirements, if any, shall comply with BCSI B3. Install necessary supplemental permanent bracing and related components to enable trusses to maintain design spacing, withstand live and dead loads including lateral loads, and to comply with other indicated requirements.

G. Anchor trusses securely at all bearing points to comply with methods and details indicated.

H. Do not cut, notch, bore, drill or remove truss members.

I. Hanging Loads: Hangers for mechanical, electrical, plumbing and fire protection systems, including but not by limitation, piping, conduit, ducting and mechanical equipment, shall be made to top of the bottom chord of the truss. Connections that require fasteners to penetrate the chord longitudinally shall not be utilized. Hanger loads shall be placed at truss panel points where required by the truss design.

J. Metal plates shall not be removed and/or be replaced. Plates that are not fully pressed into the wood shall not be repaired without the direction of the Truss Manufacturer. The Engineer and Truss Manufacturer shall be notified of deficient metal plate installation. Repairs shall be submitted to the Engineer for review prior to implementation.

END OF SECTION

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior standing and running trim.
2. Shelving

B. Related Sections include the following:
1. Division 06 Section "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view

1.3 DEFINITIONS

A. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NHLA: National Hardwood Lumber Association.
3. NLGA: National Lumber Grades Authority.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

B. MDF: Medium-density fiberboard.

C. MDO Plywood: Plywood with a medium-density overlay on the face.

1.4 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical treatment manufacturer's written instructions for finishing treated material.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Samples for Initial Selection: For each type of paneling indicated.

C. Samples for Verification:

1. For each species and cut of lumber and panel products with non-factory-applied finish, with 1/2 of exposed surface finished, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.
2. For each finish system and color of lumber and panel products with factory-applied finish, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.

D. Research/Evaluation Reports: Showing that fire-retardant-treated wood complies with building code in effect for Project.

E. Warranty: Special warranty specified in this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect materials against weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation within and around stacks and under temporary coverings.

B. Deliver interior finish carpentry materials only when environmental conditions meet requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable grading rules of inspection agencies certified by ALSC's Board of Review.

1. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
2. For exposed lumber, mark grade stamp on end or back of each piece

B. Softwood Plywood: DOC PS 1.

C. Hardboard: AHA A135.4.

D. MDF: ANSI A208.2, Grade

E. Particleboard: ANSI A208.1, Grade

F. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

1. Color [**As selected by Architect from manufacturer's full range**]

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Lumber: AWPA C2. Kiln dry after treatment to a maximum moisture content of 19 percent.

B. Plywood: AWPA C9. Kiln dry after treatment to a maximum moisture content of 18 percent.

C. Preservative Chemicals: Acceptable to authorities having jurisdiction.

D. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.

E. Do not use material that is warped or does not comply with requirements for untreated material.

F. Mark lumber with treatment quality mark of an inspection agency approved by ALSC's Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. Lumber: Comply with performance requirements in AWPA C20. Kiln dry after treatment to a maximum moisture content of 19 percent.

B. Plywood: Comply with performance requirements in AWPA C27. Kiln dry after treatment to a maximum moisture content of 15 percent.

C. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not contain colorants and provide materials that do not have marks from spacer sticks on the exposed face.

D. Do not use material that does not comply with requirements for untreated material or is warped or discolored.

E. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

1. For exposed lumber indicated to receive a stained or natural finish.
2. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.

F. Application: [**Where required by code**].

2.4 STANDING AND RUNNING TRIM

A. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: [**White Birch**]
2. Maximum Moisture Content: [**10**] percent.
3. Finger Jointing: Not allowed.
4. Gluing for Width:
5. Veneered Material:
6. Face Surface:
7. Matching: Selected for compatible grain and color.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

1. Where galvanized finish is indicated, provide fasteners and anchorages with hot-dip galvanized coating complying with ASTM A 153/A 153M.

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

1. Use wood glue that has a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.

1. Use adhesive that has a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FABRICATION

A. Back out or kerf backs of the following members except those with ends exposed in finished work:

1. Interior standing and running trim except shoe and crown molds.
2. Wood board paneling.

B. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

1. Do not use manufactured units with defective surfaces, sizes, or patterns.

B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
2. Countersink fasteners, fill surface flush, and sand where face fastening is unavoidable.

3. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
4. Install stairs with no more than 3/16-inch (4.7-mm) variation between adjacent treads and risers and with no more than 3/8-inch (9.5-mm) variation between largest and smallest treads and risers within each flight.
5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary. Stagger joints in adjacent and related standing and running trim. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.

1. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
2. Install trim after gypsum board joint finishing operations are completed.
3. Drill pilot holes in hardwood before fastening to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 ADJUSTING

A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.6 CLEANING

A. Clean interior finish carpentry on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.7 PROTECTION

A. Protect installed products from damage from weather and other causes during remainder of the construction period.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062023

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Interior standing and running trim.

B. Plastic-laminate and wood-veneered cabinets.

C. Solid-surfacing-material countertops.

D. Wood paneling.

E. Tackable panels.

F. Plastic laminate lockers in the Simulation Room.

G. Wood Window Frames

1.3 DEFINITIONS

A. Architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, including cabinet hardware and accessories and finishing materials and processes.

B. Product Data: For panel products, high-pressure decorative laminate, solid-surfacing material, each type of tackable panel, cabinet hardware and accessories, and finishing materials and processes.

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures and other items installed in architectural woodwork.

D. Samples:

1. Solid lumber and wood veneers with transparent finish, each not less than 50 sq. in. (300 sq. cm), for each species and cut, finished on 1 side and 1 edge.
2. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with 1 sample applied to core material.
3. Solid-surfacing materials, 6 inches (150 mm) square.
4. Exposed cabinet hardware and accessories, one unit for each type and finish.
5. Fabric for tackable panels, 12” x 12”.

1.5 QUALITY ASSURANCE

A. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards," Eighth Edition, for grades of architectural woodwork indicated for construction, finishes, installation, and other requirements.

B. Pre-installation Conference: Conduct conference at Project site to review issues that will affect the Work of this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wood Species and Cut for Transparent Finish: As selected by the Architect.

B. Composite Wood Products: Made without added urea formaldehyde.

C. Cabinet Hardware:

1. Hinges: Frameless, concealed.
2. Pulls: Hafele #109.74.601 zinc with brushed nickel finish.
3. Locks: Door and/or drawer, as indicated.
4. Exposed Hardware Finishes: Satin chromium plated and/or Satin stainless steel.
5. Grommets for Cable Passage through Countertops: Model No. EDP2 Flip-Top Grommet Cap by Doug Mockett & Company, Inc.; molded-plastic; for 2-9/32" hole; 3" overall diameter; 7/8" x 1-3/16" cord slot; flip-top tab covers cord slot when not in use; color as selected by the Architect from the manufacturer's full range.

D. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112.

E. Drawer Slides: BHMA A156.9, B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
2. Box Drawer Slides: Grade 1; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.
3. Pencil Drawer Slides: Grade 1; for drawers not more than 3 inches (75 mm) high and 24 inches (600 mm) wide.
4. Keyboard Tray System: Provided by Owner and installed by Contractor. Model to be determined.
5. Counter Support Brackets: Rakks counter support brackets, clear anodized aluminum by Rangine Corp., Needham, MA. Depth, load capacity, and mounting method, as required to suit conditions.
    a. Vanity Support Brackets (in toilet rooms): Rakks EHV-Vanity Supports, ADA-compliant aluminum brackets with wooden strips on front for mounting.

F. Interior Standing and Running Trim for Transparent Finish:

1. Interior wood column surrounds. Wood veneer plywood with solid birch at edges and corners, custom built on-site. Also used for solid birch as a top for some low 2-tier lockers in the simulation lab. White Birch, rotary cut and clear #0-95 finish.
2. Wood fireplace mantel, wood species to be determined.

G. Wood Window Frames: Wood-framed interior window, birch to match other interior wood. Fixed, single pane 1/4" tempered glass; custom-built unit, integral with interior wood bookshelf adjacent to it. White Birch, rotary cut and clear #0-95 finish.

H. Provide a built-in book case and two (2) reception desks fabricated of a front panel consisting of wood veneer plywood with solid wood for reveals and for covering ends of the plywood.

I. Plastic-Laminate Cabinets:

1. Grade: Custom.
2. AWI Type of Cabinet Construction: Flush overlay, unless otherwise indicated.
3. Cabinet Interior: Thermoset decorative panels.
4. Colors and Patterns: As selected by the Architect, including woodgrains.

J. Wood Cabinets for Transparent Finish:

1. Grade: Custom.

2. Wood: Hardwood veneer plywood to match the Architect's approved Samples.
3. AWI Type of Cabinet Construction: Flush overlay, unless otherwise indicated.

a. Veneer Matching: Book match veneer leaves and balance match within panel face, unless otherwise indicated.

1) Cabinet veneers in each space from a single flitch; match Architect's approved Sample.
2) Cabinet Interior: Thermoset decorative panels.
3) Provide solid wood reveals, as indicated.

K. Solid-Surfacing-Material Countertops:

1. Grade: Custom.
2. Thickness: 3/4 inch (19 mm), unless otherwise indicated.
3. Provide eased edges at all outside corners.
4. Coordinate location of grommets with the Owner prior to fabrication.

L. Wood Paneling: Plywood with birch veneer, solid wood at panel ends for reveals. Solid wood shelf niches incorporated into the overall wall design for display areas and bookshelves. Coordinate with telecomm for wiring and data ports for electronic displays. White Birch, rotary cut and clear #0-95 finish. At receiving room, pine plywood wainscot on walls to 4'-0" high with 2x4 wood base and chair rail. Designed to be a wall protection.

M. Tackable Panels:

1. Type 1 (at casework): Premium quality, pure grain, flame-retardant natural cork, 1/4" thick. Fully adhere cork to substrate using commercial grade contact adhesive.
2. Type 2 (at walls): Fabric-wrapped premium quality, pure grain, flame-retardant natural cork, 1/4" thick, laminated to 1/4" thick hardboard backing. Fabric shall be stretch-applied to panel face and bonded to panel edges with a minimum 1" return on back of panels. Fabric shall be flat, wrinkle-free, and fully tailored at corners with no exposed darting. Fabric shall be as scheduled on the Drawings.
   a. Mount Type 2 panels using 20 gauge steel wall clips and panel clips. Provide shims and adjustments so as to maintain consistent alignment of joints and finished panel faces and to ensure unstressed clip/mounting locations.

2.2 FABRICATION, GENERAL

A. Woodwork Grade: Unless otherwise indicated, provide Custom-grade woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to 1/16 inch radius indicated for corners of cabinets and edges of solid-wood (lumber) members and rails.

D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs. Seal edges of openings in countertops with a coat of varnish.

2.3 SHOP FINISHING

A. Grade: Premium.

B. Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper.

D. Transparent Finishes:

1. AWI Finish System: Conversion varnish.
2. Staining: Match Architect’s approved samples.
3. Wash Coat: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
4. Topcoats: Two topcoats.
5. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

E. Fire-retardant Coating: Exposed wood including but not limited to wood paneling, shall receive a clear, Class A fire-retardant coating similar to Flame Resist as manufactured by Hy-Tech Thermal Solutions; zero flame spread; odorless.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches (900 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

1. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).

G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.

3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or hanging strips.

H. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
3. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.
4. Caulk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

I. Paneling: Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening, unless otherwise indicated.

J. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 07100

CEMENTITIOUS WATERPROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes cementitious waterproofing for elevator pits.

B. Related Sections include the following:
1. Division 3 Section "Cast-in-Place Concrete."

1.03 SUBMITTALS

A. General: Submit in accordance with Section 01330.

B. Product Data: For each type of product indicated, including installation instructions.

C. Qualification Data: For Installer.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced waterproofing Applicator.

B. Source Limitations: Obtain cementitious waterproofing materials through one source from a single manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store materials and equipment in a single area of project site. Provide adequate means to protect floors and adjacent surfaces of this area from damage.

1.06 PROJECT CONDITIONS

A. Weather Limitations: Do not apply waterproofing when effects of freezing or moisture will adversely affect the waterproofing application.

B. Maintain adequate ventilation during preparation and application of cementitious waterproofing materials.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cementitious Waterproofing: "Five Star Waterproofing" trowel applied negative side cementitious membrane and mixing liquid system manufactured by WCM.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Applicator present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.
   1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
   2. If unacceptable conditions are encountered, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
   3. Application of coating to surfaces shall constitute acceptance of surfaces and conditions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surfaces must be clean. Chip or grind off all defective materials and foreign matter. Remove form treatment residue, curing compound, scum and fungus.

B. Repair cracks, breaks, honeycombing, or other surface imperfections with non-expansive patching mortar to attain a finish comparable to adjacent concrete surfaces.

3.03 INSTALLATION

A. Cementitious Waterproofing:
   1. Apply cementitious waterproofing treatment to the floor and walls of elevator pit to a minimum thickness of 1/8-inch after elevator jack hole has been poured around with cast-in-place concrete.
   2. Trowel all surfaces to a smooth, hard finish, free from pits hollows and other defects.
   3. Provide 1-inch by 1-inch cant at intersection of horizontal and vertical surfaces.
   4. Apply in strict accordance with manufacturer's instructions.

3.04 PROTECTION

A. Protect waterproofing from damage by other trades after installation to maintain the integrity of the waterproofing.

END OF SECTION 07100

SECTION 072100

BUILDING INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Insulation under slabs-on-grade.

2. Foundation wall insulation (supporting backfill).

3. Concealed building insulation.

4. Closed Cell Foam-in-place insulation.

5. Vapor retarders.

B. Related Sections include the following:
1. Division 3 Section "Cast-in-Place Concrete" for vapor barrier under slabs-on-grade.
2. Division 4 Section "Unit Masonry Assemblies" for insulation installed in cavity walls.
3. Division 7 Section "Self-Adhering Sheet Air/Vapor Barrier System."
4. Division 7 Section "EPDM-Single-Ply Membrane Roofing" for insulation specified as part of roofing construction.
5. Division 9 Section "Gypsum Board Assemblies" for provision in metal-framed assemblies of interior acoustical insulation and for provision of rigid insulation installed in z-furring.
6. Division 15 Sections for insulation on ducts, piping, and equipment.

1.03 DEFINITIONS

A. Thermal Resistivity: Where the thermal resistivity of insulation products are designated by "r-values," they represent the reciprocal of thermal conductivity (k-values). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.

1.04 SUBMITTALS

A. General: Submit in accordance with Section 01330.

B. Product Data: For each type of product indicated.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulation products.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of Work.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
   1. Surface-Burning Characteristics: ASTM E 84.
   2. Fire-Resistance Ratings: ASTM E 119.
   3. Combustion Characteristics: ASTM E 136.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect plastic insulation as follows:
   1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
   3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.07 COORDINATION

A. Sequence and coordinate installation of firesafing components specified in this and other Sections to assure completed system complies with required fire-resistance ratings and that firesafing remains dry.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

C. Products: Subject to compliance with requirements, provide one of the products specified.

2.02 INSULATING MATERIALS

A. General: Provide insulating materials that comply with requirements and with referenced standards.
   1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.

B. Perimeter Insulation: Extruded-polystyrene board insulation, ASTM C 578, Type IV, 1.60 lb./cu. ft., unless otherwise indicated, with maximum flame-spread and smoke-developed indices of 75 and 450, respectively:
   1. Thickness: 2 inch, unless otherwise noted.
   2. Edge Condition: Tongue and groove or shiplap edges for stacked insulation.
      Products:
      a. Styrofoam; Dow Chemical Company.
      b. Foamular 250; Owens Corning.
      c. Amofoam; Tenneco Building Products.

C. Rigid Insulation: Extruded-polystyrene board insulation, ASTM C 578, Type IV, 1.60 lb./cu. ft., unless otherwise indicated, with maximum flame-spread and smoke-developed indices of 75 and 450, respectively:
   1. Thickness: 2-1/2 inch, unless otherwise noted.
   2. Edge Condition: Square edge for installation in z-furring.
   3. Products:
      a. Styrofoam; Dow Chemical Company.
      b. Foamular 250; Owens Corning.
      c. Amofoam; Tenneco Building Products.

D. Unfaced Mineral-Fiber Blanket (Batt) Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from glass; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
   1. Thickness: Per drawing, unless otherwise noted.

   2. Manufacturers:
      a. CertainTeed Corporation.
      b. Owens Corning.
      c. Johns Manville Corporation.

E. Sound Attenuation Blankets (Acoustical Insulation): See Division 9 Section "Gypsum Board Assemblies.

F. Foam-In-Place Insulation: HFC-blown type Closed Cell Foam: Closed Cell Foam is a medium-density, MDI-based polyurethane thermoset rigid foam.
   1. Physical and Mechanical Properties:

   2. Core Density: 1.9-2.4 pcf when tested in accordance with ASTM D 1622.

   3. Thermal Resistance (aged): 5.8 less than or equal to 2-1/2 inches / 6.4 when greater than 2-1/2 inches when tested in accordance with ASTM C 518 at 75 degrees F, (h-ft2-degrees F)/Btu.

   4. Closed Cell Content: 88-95 percent when tested in accordance with ASTM D 2842.

5. Compressive Strength: Greater than 25 psi when tested in accordance with ASTM D 1621.

6. Tensile Strength: 23 psi when tested in accordance with ASTM D 1623.

7. Water Absorption: Less than 2 percent by volume when tested in accordance with ASTM D 2842.

8. Dimensional Stability: Less than 9 percent by volume when tested in accordance with ASTM D 2126 at 75 degrees F/95 percent RH, 28 Day.

9. Water Vapor Transmission: 1.3 perm/inch when tested in accordance with ASTM E 96.

10. Air Permeability: 0.013 when tested in accordance with ASTM E 283 at 1 inch thickness, L/s/m2.

11. Fungi Resistance: Pass, with no growth when tested in accordance with ASTM C 1338.

12. Fire performance

    a. Flame Spread: Less than 25 when tested in accordance with ASTM E 84.

    b. Smoke: Less than 450 when tested in accordance with ASTM E 84.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.03 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.04 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

A. On vertical surfaces, set units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
Extend insulation to top of footing or full height of grade beam depending on campus.

B. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection board. Set in adhesive according to insulation manufacturer's written instructions.

C. Protect top surface of horizontal insulation from damage during concrete work.

3.05 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units. Fill voids in thermal envelope not covered by the work of other sections.

B. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Install glass-fiber blankets in cavities formed by framing members according to the following requirements:
Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
Install insulation support anchors at top of cavity and spaced every 5 feet on center full length of each cavity.

3.06 INSTALLATION OF FOAM-IN-PLACE INSULATION

A. Install foam-in-place insulation sealant to a minimum depth of 1 inch, sealing roof deck flutes and construction cracks and gaps where outside air and cold can infiltrate, providing an airtight building envelope.

3.07 INSTALLATION OF VAPOR RETARDERS

A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
Location: Underside of roof trusses, sloped framing, and attic walls where indicated at SMCC.

B. Seal vertical joints in vapor retarders over framing by lapping not less than two wall studs. Fasten vapor retarders to framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches o.c.
At attic walls, seal bottom of vapor retarder to concrete plank.

C. Seal overlapping joints in vapor retarders with adhesives or vapor-retarder tape according to vapor-retarder manufacturer's instructions. Seal butt joints and fastener penetrations with vapor-retarder tape. Locate all joints over framing members or other solid substrates.

D. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor-retarder manufacturer.

E. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.

F. Tie vapor retarder on underside of trusses and sloped framing into air/vapor barrier provided in Division 7 Section "Self-Adhering Sheet Waterproofing."

G. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.08 PROTECTION

A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07210

SECTION 072710

AIR/VAPOR BARRIER SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes vapor-retarding, modified bituminous sheet air/vapor barriers on weather resistant gypsum sheathing and fluid-applied air/vapor barriers on concrete masonry units.

B. Related Sections include the following:
1. Division 5 Section "Cold Formed Metal Framing" for wall sheathings receiving air/vapor barrier.
2. Division 7 Section "Joint Sealants" for joint-sealant materials and installation.

1.03 DEFINITIONS

A. Air/Vapor Barrier Assembly: The collection of air/vapor barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.04 PERFORMANCE REQUIREMENTS

A. General: Air/vapor barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air/vapor barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits. Barrier shall be continuous with all joints made air-tight and shall have the following characteristics:
1. Air Barrier Assembly Air Leakage: Not to exceed 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft.; ASTM E 283.
2. Water Vapor Permeance: Shall not exceed 0.05 perms for 40-mil dry coating grams/ft²/hr in Hg when tested in accordance with ASTM E 96.
3. Liquid Water Absorption: Less than 0.12% (weight) when tested in accordance with ASTM D 570.
4. Shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on envelope without damage or displacement; shall transfer load to structure; and shall not displace adjacent materials under full load.
5. Shall be joined in an airtight, flexible manner to the air/vapor barrier surface/material of adjacent systems, allowing for relative movement of systems due to thermal and moisture variations or creep. Air/vapor barrier shall be connected to the following system components:
   a. Foundation and walls.
   b. Doors and windows penetrating exterior walls.
   c. Aluminum-framed entrances and storefronts.
   d. Different wall systems.
   e. Roof assemblies.
   f. Wall and roof intersections.
   g. Walls and roof assemblies over unconditioned space.
   h. Wall, floor and roof assemblies spanning control and expansion joints.
   i. Wall, floor and roof penetrations by masonry ties, screws, bolts and similar items.

j. Wall, floor and roof penetrations by pipes, ducts, and conduits.

B. Air/Vapor Barrier Penetrations: All penetrations of the air/vapor barrier and paths of air infiltration or exfiltration shall be made airtight to not less than the rating of the air/vapor barrier.

1.05 SUBMITTALS

A. General: Submit in accordance with Section 01330.

B. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air/vapor barrier.

C. Shop Drawings: Show locations and extent of air/vapor barrier. Include details of intersections with other envelope systems and materials; details of membrane counter-flashings; details for substrate joints and cracks, counterflashing strip, and penetrations; details for inside and outside corners; details for terminations, and tie-ins with adjoining construction. Show relationship to adjacent materials, sequence of installation and materials, and methods for sealing penetrations. Shop Drawings shall include connection details between the air/vapor barrier and for the following exterior envelope components as applicable to the Project:
1. Foundations and walls.
2. Doors and windows.
3. Aluminum-framed entrances and storefronts.
4. Wall and roof assemblies.
5. Wall penetrations by pipes, ducts and conduits.

D. Product Certificates: For air/vapor barriers, certifying compatibility of air/vapor barrier and accessory materials with Project materials that connect to or that come in contact with air/vapor barrier; signed by product manufacturer.

E. Qualification Data: For Applicator.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air/vapor barriers.

1.06 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying air/vapor barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance and is approved in writing by air/vapor barrier membrane manufacturer.

B. Mockups: Apply air/vapor barrier membrane mockup to exterior wall assembly built in Division 5 Section "Cold Formed Metal Framing." Mockup of exterior wall assembly shall include connections between wall and foundation, wall and glazing systems, and through-wall flashings, showing relationship of materials with air/vapor barrier membrane and quality of workmanship.
1. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air/vapor barrier until mockups are approved.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups, unless such deviations are specifically approved by Architect in writing.
3. Complete mockup for review at preinstallation conference.

C. Preinstallation Conference: Conduct conference at Project site.
1. Meet with air/vapor barrier membrane Installer, air/vapor barrier membrane system manufacturer's representative, and testing agency representative. Include installers of other construction connecting to air/vapor barrier, such as roofing, waterproofing, architectural precast concrete, masonry, joint sealants, windows, glazed storefronts, and door frames.

2. Review air/vapor barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.
3. Review approved submittals.
4. Review mock-up.
5. Review and coordinate sequence of installation with adjacent materials.
6. Review compatibility of air/vapor barrier materials with building envelope materials.
7. Review interface of flashings and trim with air/vapor barrier system.
8. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
9. Procedures for quality assurance, testing, and corrective procedures.
10. Schedule for subsequent work covering air/vapor barrier membrane.
11. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
12. Provide 72-hour minimum advance notice to participants prior to convening preinstallation conference.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air/vapor barrier manufacturer. Packages shall be labeled with manufacturer's name, product brand name and type, date of manufacture, and shelf life.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Store rolls according to manufacturer's written instructions.

D. Protect stored materials from direct sunlight.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Apply air/vapor barrier within the range of ambient and substrate temperatures recommended by air/vapor barrier manufacturer. Protect substrates from environmental conditions that affect performance of air/vapor barrier. Do not apply air/vapor barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.09 WARRANTY

A. General: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer's System Warranty: Written system warranty, signed by air/vapor barrier membrane manufacturer agreeing to replace air/vapor barrier system materials and accessories which fail to achieve specified air tightness and vapor seal, exhibit loss of adhesion or cohesion, or do not cure within specified warranty period.
1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 Spray AIR/VAPOR BARRIER

A. Modified Bituminous Sheet: 40-mil- thick, self-adhering sheet consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick, polyethylene film with release liner on adhesive side and formulated for application with primer that complies with VOC limits of authorities having jurisdiction.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Carlisle Coatings & Waterproofing; CCW-705.
b. Grace, W. R. & Co.; Perm-A-Barrier.
c. Henry Company; Blueskin SA.
2. Physical and Performance Properties:
a. Membrane Air Permeance: Not to exceed 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
b. Tensile Strength: 500 psi minimum; ASTM D 412, Die C, modified.
c. Ultimate Elongation: 200 percent minimum; ASTM D 412, Die C, modified.
d. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970.
e. Puncture Resistance: 40 lbf minimum; ASTM E 154.
f. Water Absorption: 0.12 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
g. Vapor Permeance: 0.05 perms; ASTM E 96, Water Method.

2.02 FLUID-APPLIED AIR/VAPOR BARRIER MEMBRANE FOR CONCRETE MASONRY UNITS

A. Fluid-Applied Air/Vapor Barrier Membrane: Provide one the of the following:
1. Perm-A-Barrier Liquid Air/Vapor Barrier Fluid-Applied Membrane, two-part, self-curing, rubber-based fluid for spray application; Grace Construction Products.
2. BARRISEAL-S spray grade water-based asphalt emulsion modified with a blend of synthetic rubbers and special additives, compatible with sheet membranes, complying with specified thickness; Carlisle Coatings and Waterproofing, Inc.
3. Note: fluid-applied air/vapor permitted for block only. Self-adhering sheet air barriers shall be used on weather-resistant gypsum sheathing.

B. If a fluid-applied air/vapor barrier membrane using above products is considered for application to weather-resistant gypsum sheathing, it shall be applied to achieve a dry film thickness not less than 60 mils thickness.

2.03 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by air/vapor barrier manufacturer for intended use and compatible with air/vapor barrier. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne primer recommended for substrate by manufacturer of air/vapor barrier material.

C. Counterflashing Strip: Modified bituminous 40-mil- thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil- thick, crosslaminated polyethylene film with release liner backing.
1. Products:
a. CCW-705-TWF; Carlisle Coatings & Waterproofing, Inc.
b. Perm-A-Barrier Wall Flashing; Grace Construction Products.
c. Blueskin TWF; Henry Company.

D. Butyl Strip for Transition at Single Ply Membrane Roofing: Vapor-retarding, 30- to 40-mil- thick, self adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive, with release liner backing.

E. Modified Bituminous Strip: Vapor-retarding, 40-mil- thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick polyethylene film with release liner backing.

F. Termination Mastic: Cold fluid-applied elastomeric liquid; trowel grade.

G. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

H. Adhesive and Tape: Air/vapor barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

I. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.

J. Sprayed Polyurethane Foam Sealant: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft. density; flame spread index of 25 or less according to ASTM E 162; initial R-Value (at 1 inch) of not less than 7; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

K. Modified Bituminous Transition Strip: Vapor-retarding, 40-mil- thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick polyethylene film with release liner backing.

L. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Division 7 Section "Joint Sealants."

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air/vapor barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.
5. Weather-Resistant Gypsum Sheathing: Verify that boards are sufficiently stabilized with corners and edges fastened with appropriate screws at proper spacing.
6. If unacceptable conditions are encountered, prepare written report, endorsed by Applicator, listing conditions detrimental to performance of work.
7. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air/vapor barrier application.

B. Mask off adjoining surfaces not covered by air/vapor barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
1. Install modified bituminous strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.

G. Fill gaps between different substrate systems; gaps between substrates and window, door, and storefront systems; and miscellaneous penetrations in substrates with sealant.
1. Apply foam sealant in gaps up to 2 inches wide.
2. Apply insulation foam sealant in gaps greater the 2 inches wide.
3. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

H. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall and deck-to-deck joints with overlapping modified bituminous strips.
1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.

I. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

J. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air/vapor barrier.

K. Concrete Masonry Unit Substrates:
1. Fill all voids and holes, particularly in the mortar joints, with a lean mortar mix, non-shrinking grout or parge coat.
2. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
3. Prime with conditioning primer when installing modified asphalt membrane transition membranes. Apply primer at required rate and allow to dry. Limit priming to areas that will be covered by air/vapor barrier in same day. Reprime areas exposed for more than 24 hours.

3.03 INSTALLATION

A. Install modified bituminous sheets according to air/vapor barrier manufacturer's written instructions and according to recommendations in ASTM D 6135.
1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous air/vapor barrier sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
2. Do not apply to wet or frozen substrates.
3. Do not allow contamination with dust or dirt.
4. Seal completely at edges, perimeter and penetrations.
5. Wrap membrane around perimeter of window openings, so the window systems can be caulked around the interior perimeter of opening, sealing between edge of window and air/vapor barrier.

B. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
1. Install modified bituminous strips centered over vertical inside corners. Install 3/4-inch fillets of termination mastic on horizontal inside corners.

C. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D 6135.

D. Apply primer to substrates at required rate and allow to dry thoroughly. Adjust time for drying, based upon ambient temperature, humidity and weather conditions. Limit priming to areas that will be covered by air/vapor barrier sheet in same day. Reprime areas exposed for more than 24 hours.
1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

E. Apply and firmly adhere modified bituminous sheets horizontally over area to receive air/vapor barrier sheets. Accurately align sheets and maintain a uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure airtight installation.
1. Apply sheets in a shingled manner to shed water without interception by any exposed sheet edges.
2. Roll sheets firmly to enhance adhesion to substrate.

F. Apply continuous modified bituminous sheets over modified bituminous strips bridging substrate cracks, construction, and contraction joints.

G. CMU: Apply fluid-applied air/vapor barrier in a continuous, uniform film using multiple, overlapping passes to achieve a dry film thickness not less than 60 mils thick.
1. Inspect sprayed surfaces and fill any remaining gaps.
2. Allow spray-applied membrane to cure to tack-free. Apply transition membrane with an overlap of not less than 3 inches onto each surface at all beams, columns and joints as indicated in detail drawings and on approved Shop Drawings.
    a. Tie in to door frames, storefront framing, roof and floor intersections, and changes in substrate.
    b. Seal top edge of transition membranes and flashing with termination mastic.

H. Seal top of through-wall flashings to air/vapor barrier sheet with an additional 6-inch- wide, counterflashing strip. Seal exposed top edge of counterflashing strip with bead of mastic as recommended by air/vapor barrier manufacturer.

I. Seal exposed edges of sheets at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Install air/vapor barrier sheets and auxiliary materials to form a seal with adjacent construction and to maintain a continuous air/vapor barrier.
1. Coordinate the installation of air/vapor barrier with installation of roofing membrane and base flashing to ensure continuity of air/vapor barrier with roofing membrane.
2. Install butyl strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over both substrates.

K. Connect and seal exterior wall air/vapor barrier membrane continuously to roofing membrane air/vapor barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings using accessory materials as indicated.

L. Wall Openings: Prime concealed perimeter frame surfaces of windows, storefronts, and doors. Apply modified bituminous transition strip so that a minimum of 3 inches of coverage is achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.
1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.

M. At base of walls, apply air/vapor barrier to seal transition between top of foundation and wall. Apply air/vapor barrier to back and bottom of brick shelves, stopping barrier 1 inch back from outside face of foundation wall.

N. Fill gaps in perimeter frame surfaces of windows, storefronts, doors, and miscellaneous penetrations of air/vapor barrier membrane with foam sealant.

O. At end or each working day, seal top edge of membrane to substrate with termination mastic.

P. Apply joint sealants forming part of air/vapor barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

Q. Repair punctures, voids, and deficient lapped seams in air/vapor barrier. Slit and flatten fishmouths and blisters. Patch with air/vapor barrier sheet extending 6 inches beyond repaired areas in all directions.

R. Do not cover air/vapor barrier until it has been tested and inspected by inspection testing agency.

S. Correct deficiencies in or remove air/vapor barrier that does not comply with requirements; repair substrates and reapply air/vapor barrier components.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Inspections: Air/vapor barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
1. Continuity of air/vapor barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air/vapor barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed.
7. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Air/vapor barrier has been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Remove and replace deficient air/vapor barrier components and retest as specified above.

3.05 CLEANING AND PROTECTION

A. Protect air/vapor barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
1. Protect air/vapor barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air/vapor barrier exposed to these conditions for more than 30 days.
2. Protect air/vapor barrier from contact with creosote, uncured coal-tar products, EPDM, and sealants not approved by air/vapor barrier manufacturer.

B. Clean spills, stains, and soiling from adjacent construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07271

SECTION 073113 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Asphalt shingles.
2. Felt underlayment.
3. Self-adhering sheet underlayment.
4. Ridge vents.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Samples: For asphalt shingles, and ridge cap shingles.

C. Product test reports.

D. Research/evaluation reports.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain ridge and hip cap shingles felt underlayment and self-adhering sheet underlayment through one source from a single asphalt shingle manufacturer.

B. Fire-Test-Response Characteristics: Provide asphalt shingle and related roofing materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class **A**; ASTM E 108 or UL 790, for application and roof slopes indicated.

C. Preinstallation Conference: Conduct conference at Project site.

1.4 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace asphalt shingles that fail in materials within specified warranty period.

1. Material Warranty Period: 30 years from date of Substantial Completion, prorated, with first 3 years nonprorated.

2. Algae-Discoloration Warranty Period: Asphalt shingles will not discolor five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Products: Provide Hatteras by CertainTeed or architect approved equal.
   2. Color: Selected from Manufacturers full range of colors

B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

2.2 UNDERLAYMENT MATERIALS

A. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D 1970, minimum of 40-mil-(1.0- mm-) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release paper backing; cold applied.

2.3 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.

B. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized steel wire shingle nails, minimum 0.120-inch- (3-mm-) diameter, barbed shank, sharp-pointed, with a minimum 3/8-inch- (9.5-mm-) diameter flat head and of sufficient length to penetrate 3/4 inch (19 mm) into solid wood decking or extend at least 1/8 inch (3 mm) through OSB or plywood sheathing.

   1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

C. Felt Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized steel wire with low profile capped heads or disc caps, 1-inch (25-mm) minimum diameter.

2.4 METAL FLASHING AND TRIM

A. Sheet Metal Flashing and Trim: Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim."

   1. Sheet Metal: Anodized aluminum.

   2. Color: Dark Bronze

B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated, lapped in direction to shed water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Roll laps with roller. Cover underlayment within seven days.

3.2 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim."

1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

3.3 ASPHALT SHINGLE INSTALLATION

A. Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip at least 7 inches (175 mm) wide with self-sealing strip face up at roof edge.

1. Extend asphalt shingles 1/2 inch (13 mm) over fascia at eaves and rakes.

C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Fasten asphalt shingle strips with a minimum of four roofing nails located according to manufacturer's written instructions.

END OF SECTION 073113

SECTION 074200 - WALL PANELS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Section 07 42 43 - Composite Wall Panels.
B. Moldings.
C. Fasteners and adhesives.

1.2 RELATED SECTIONS

A. Section 05 40 00 - Cold Formed Metal Framing: Structural stud backing.
B. Section 06 10 00 - Rough Carpentry: Structural stud backing.
C. Section 07 21 00 - Thermal Insulation.
D. Section 07 92 00 - Joint Sealants.
E. Section 09 21 16 - Gypsum Board Assemblies: Gypsum sheathing.

1.3 REFERENCES

A. ASTM C 177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
B. ASTM D 256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
C. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.
D. ASTM D 785 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
E. ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
F. ASTM D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
G. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
H. ASTM 696 – Thermal Expansion

1.4 SUBMITTALS

A. Submit under provisions of Section 01 30 00.
B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: Include elevations and detail sections of installation. Include cutting and setting drawings indicating sizes, dimensions, sections, and profiles of panels; arrangements

and provisions for jointing, supporting, anchoring, and bonding panels; and details showing relationship with, attachment to, and reception of related work. Include large-scale details of each system component, anchorage, and fastening device.

D. Selection Samples: Architects selection from full range of color and texture combinations.

E. Verification Samples: For each panel specified, two samples, minimum size 3-1/2 inches square, representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide products by a manufacturer with experience completing at least five projects of the size, scope and quality required by this project within the last five years. Provide all composite architectural panels by a single manufacturer.

B. Installer Qualifications: Not less than three years of successful experience in completing exterior cladding systems similar in material and scope to this project.

C. Mock-Up: Provide a mock-up for evaluation of installation techniques and finished appearance.

1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship and overall appearance are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.
4. Approved mock-up may be incorporated into the completed work

1.6 PRE-INSTALLATION MEETING

A. For all installation systems, convene meeting to review manufacturer’s recommended procedure no less than one week before panel installation is scheduled to begin. Assure attendance by representatives of Architect, Contractor, installer, and panel manufacturer’s representative.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver panels in crates on wood pallets, interwoven with protective paper and wrapped in plastic sheets.

B. Store panels flat in original shipping crates or on wood pallets under protective cover until needed for installation. Ventilate coverings to avoid condensation. Elevate above grade on level blocking to avoid standing water.

C. Protect panels from scuffing during handling, and apply manufacturer's recommended remedial treatment immediately if panels are soiled or scratched. Carry panels on edge and handle carefully to avoid damage to surfaces and corner.

1.8 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Comply with manufacturer's project review requirements and notification procedures to assure qualification for warranty.
C. See Section 01 78 36 - Provide manufacturer's standard 10-year warranty for non-load bearing structural integrity of panels.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer of Petrarch Architectural Panels: CEP Panels, Inc; 22 E. Chicago Avenue, Suite 210; Naperville, IL 60540. ASD. Tel: (800) 450-6099 or (630) 355-4040. Fax: (630) 355-4995. Email: mark.goetz@cep-panels.com. Website: www.cep-panels.com or architect approved equal.

2.2 COMPOSITE ARCHITECTURAL PANELS

B. Petrarch Panels: **5/16 inch** thick composite sheets comprising natural slate and/or stone granules or powder and/or calcium carbonate granules or powder, polyester resin, glass fiber, pigments, and fire retardant, with homogeneous color throughout.

1. Weight: 4.5 lb/sq ft.
2. Width: 47-3/4 inches.
3. Length: 95-3/4 inches.
4. Length: 119-3/4 inches.
5. Density: 2.27, per ASTM D 792.
6. Modulus of Rupture: 5850 psi (40.3 MPa), when tested in accordance with ASTM D 790 (ASTM D 790M).
7. Tensile Strength: 2880 psi (19.8 MPa), when tested in accordance with ASTM D 638.
8. Thermal Conductivity: 5.822 BTU-in/hr sq ft (120.8 W/m K), when tested in accordance with ASTM C 177.
9. Izod Impact: 0.43 ft-lb/in (0.008 J/m) of notch, when tested in accordance with ASTM D 256.
10. Hardness Barcol: 64, when tested in accordance with ASTM D 785.
11. Flame Spread: 15, when tested in accordance with ASTM E 84.
12. Fuel Contribution: 0, when tested in accordance with ASTM E 84.
13. Moisture Absorption: Maximum 0.2 percent by weight after 24 hours of immersion.
14. Biological Resistance: Immune to insect and vermin attack; inhibits mold growth.
15. Chemical Resistance: Impervious to most acid and organic solvents.

C. Manufacturing Tolerances:

1. Sheet size tolerance: Plus or minus 1/8 inch.
2. Thickness tolerance: Plus or minus 1/16 inch.
3. Riven textured surface: An additional plus or minus 1/16 inch.

D. Petrarch Panels Color: Graphite

E. Texture: Riven Slate.

2.3 ACCESSORIES

A. Structural Silicone Setting System:

1. Aluminum Bearing Plates: 80% recycled 6063-T5 alloy, 0.125 in thickness, Clear Anodized.

B. Face Fastened System:

1. Metal Framing: No. 10 or No. 6 Phillips, flat head, Tek point 410 stainless steel screws in lengths to suit application.
2. Wood Framing: No. 10 or No. 6 Phillips, flat head, Type A point, 18/8 stainless steel sheet metal screws in lengths to suit application.
3. Diamond Countersink Tool to suit screw size.

2.4 FABRICATION

A. Provide factory fabricated panels to the extent possible, conforming to the following:

1. Cut to custom sizes from manufacturer's standard sizes.
2. Pre-drill and countersink fastener holes.
3. Prepare special shapes and cutouts.
4. Polish, bevel, or miter edges, as indicated on drawing and exposed corners.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Measure areas of installation prior to fabrication, to minimize out of square or unbalanced border conditions.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions. Proceed with panel installation only when substrate is completely dry.

3.3 INSTALLATION

A. Install in strict accordance with manufacturer's instructions. Make adequate provisions for thermal and structural movement.

B. Field Assembled Face Fastened System:

1. Locate edge fastener holes and space fasteners within limits established by panel manufacturer
2. Install panels with joints over bond breaker tape, and seal with silicone or polyurethane joint sealer in accordance with requirements of Section 07 90 00.
3. Panels can be secured using a variety of exposed stainless steel fasteners or countersunk fasteners (patched with manufacturer's matching filler compound).

C. Field Assembled Back Fastened System:

1. Locate and space back-mounted anchors for shop installation within limits established by panel manufacturer.
2. Fasten panel assemblies to back-up framing by means of specified screws at panel joints.
3. Install weatherproofing joint sealer in accordance with requirements of Section 07 90 00.

PART 4 - CLEANING AND PROTECTION

A. Clean all panels of dirt, adhesive, and joint sealers, using detergents or solvents as appropriate and as recommended by the manufacturer.
B. Remove and replace any damaged panels and those that cannot be adequately cleaned.
C. Protect installed products until completion of project.

END OF SECTION 074243

SECTION 075323 - EPDM MEMBRANE ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Adhered membrane roofing system.
2. Roof insulation.

B. Related Sections include the following:

1. Division 5 Section "Steel Deck" for furnishing acoustical deck rib insulation.
2. Division 6 Section "**Rough Carpentry**" for wood nailers, curbs, and blocking.
3. Division 7 Section "Building Insulation" for insulation beneath the roof deck.
4. Division 7 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.
5. Division 7 Section "Joint Sealants."
6. Division 15 Section "Plumbing Specialties" for roof drains.

1.3 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

B. Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," before multiplication by a safety factor.

C. Factored Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," after multiplication by a safety factor.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

C. Roofing System Design: Provide a membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE 7.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Insulation fastening patterns.

C. Samples for Verification: For the following products:

1. 12-by-12-inch (300-by-300-mm) square of sheet roofing, of color specified, including T-shaped side and end lap seam.
2. 12-by-12-inch (300-by-300-mm) square of roof insulation.
3. 12-by-12-inch (300-by-300-mm) square of walkway pads or rolls.
4. 12-inch (300-mm) length of metal termination bars.

D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of meeting performance requirements.

F. Qualification Data: For Installer and manufacturer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.

H. Research/Evaluation Reports: For components of membrane roofing system.

I. Maintenance Data: For roofing system to include in maintenance manuals.

J. Warranties: Special warranties specified in this Section.

K. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.

B. Manufacturer Qualifications: A qualified manufacturer that has **UL listing** for membrane roofing system identical to that used for this Project.

C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

D. Source Limitations: Obtain components for membrane roofing system **approved by roofing membrane manufacturer**.

E. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class **A**; ASTM E 108, for application and roof slopes indicated.

F. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site. Comply with requirements for preinstallation conferences in Division 1 Section "Project Management and Coordination." Review methods and procedures related to roof deck construction and roofing system including, but not limited to, the following:

1. Meet with Owner; Architect; Owner's insurer if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

G. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to roofing system including, but not limited to, the following:

1. Meet with Owner; Architect; Owner's insurer if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
   1. Warranty Period: **10** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
   2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 EPDM ROOFING MEMBRANE

A. EPDM Roofing Membrane: ASTM D 4637, Type **I, nonreinforced** uniform, flexible sheet made from EPDM, and as follows:

   1. **Available** Manufacturers:

      a. Carlisle SynTec Incorporated.
      b. Firestone Building Products Company.

   2. Thickness: **60 mils (1.5 mm**, nominal.
   3. Exposed Face Color: **Black.**

2.3 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

   1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.

B. Sheet Flashing: 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.

C. Epichlorohydrin Sheet: 60-mil- (1.5-mm-) thick, unreinforced flexible sheet with the following typical properties as determined per ASTM test method indicated:

   1. Tensile Strength: 1500 psi (10.3 MPa); ASTM D 412.
   2. Ultimate Elongation: 200 percent; ASTM D 412.
   3. Tear Resistance: 150 lbf/in. (26.3 kN/m); ASTM D 412.
   4. Brittleness Temperature: Minus 20 deg F (Minus 29 deg C); ASTM D 746.

5. Resistance to Ozone Aging: No cracks after 168 hours' exposure of 50 percent elongated sample at 104 deg F (40 deg C) and 100-pphm (100-MPa) ozone; ASTM D 1149.
6. Resistance to Oil Aging: 15 percent maximum mass change after 168 hours' immersion in diesel fuel No. 2 at 158 deg F (70 deg C); ASTM D 471.

D. Bonding Adhesive: Manufacturer's standard bonding adhesive.

E. Cold Fluid-Applied Membrane Adhesive: Manufacturer's standard cold fluid-applied bonding adhesive formulated to adhere fleece-backed roofing membrane to substrate.

F. Seaming Material: **Single-component butyl splicing adhesive and splice cleaner**.

G. Lap Sealant: Manufacturer's standard single-component sealant**, color to match roofing membrane**.

H. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

I. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

J. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

K. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.4 ROOF INSULATION

A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.

B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type **IV, 1.6-lb/cu. ft. (26-kg/cu. m)** minimum density, square edged.

1. [**Available**]Manufacturers:

   a. DiversiFoam Products.
   b. Dow Chemical Company.
   c. Owens Corning.
   d. Tenneco Building Products.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48), unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.5 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Cold Fluid-Applied Adhesive: Manufacturer's standard cold fluid-applied adhesive formulated to adhere roof insulation to substrate.

2.6 ASPHALT MATERIALS

A. Roofing Asphalt: [**ASTM D 312, Type III or IV**]

B. Asphalt Primer: ASTM D 41.

2.7 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway **24"x24**" **pads** approximately 3/16 inch (5 mm) thick, and acceptable to membrane roofing system manufacturer.

1. Provide Walk way pads around the roof hatch and provide 2 pads at each HVAC unit – coordinate with mechanical

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 5 Section "Steel Deck."
4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
7. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

D. Install acoustical roof deck rib insulation strips, specified in Division 5 Section "Steel Deck," according to acoustical roof deck manufacturer's written instructions.

3.3 SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck according to recommendations in FMG's "Approval Guide" for specified Windstorm Resistance Classification.
2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturers' written instructions.

3.4 VAPOR-RETARDER INSTALLATION

A. Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively.

1. Seal side and end laps with **adhesive**.

B. Install laminate-sheet vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively. Bond vapor retarder to deck as follows:

1. Apply adhesive at rate recommended by vapor-retarder manufacturer. Seal laps with adhesive.
2. Apply ribbons of hot roofing asphalt at spacing, temperature, and rate recommended by vapor-retarder manufacturer. Seal laps with hot roofing asphalt.

C. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

3.5 INSULATION INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is **2 inches (50 mm)** or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

G. Mechanically Fastened and Adhered Insulation: Install each layer of insulation and secure first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten first layer of insulation according to requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification.
2. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
3. Install subsequent layers of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
4. Install subsequent layers of insulation in a cold fluid-applied adhesive.

3.6 ADHERED ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.

B. Start installation of roofing membrane in presence of membrane roofing system manufacturer's technical personnel.

C. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.

E. Cold Fluid-Applied Adhesive: Apply cold fluid-applied adhesive to substrate at rate required by manufacturer and install fleece-backed roofing membrane.

F. Apply roofing membrane with side laps shingled with slope of roof deck where possible.

G. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.

1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.

H. Repair tears, voids, and lapped seams in roofing that does not meet requirements.

I. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

J. Install roofing membrane and auxiliary materials to tie in to existing roofing.

K. Apply epichlorohydrin sheet over roofing membrane at locations indicated.

3.7 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings **and mechanically anchor to substrate through termination bars**.

3.8 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.

1. Notify Architect or Owner 48 hours in advance of date and time of inspection.

B. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07531

SECTION 07620 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sheet metal flashing and trim:
1. Formed low-slope roof flashing and trim.
2. Formed steep-slope roof flashing and trim.
3. Formed wall flashing and trim.
4. Formed equipment support flashing.

B. Related Sections include the following:
1. Division 4 Section "Unit Masonry Assemblies" for installing through-wall flashing, reglets, and other sheet metal flashing and trim.
2. Division 6 Section "**Rough Carpentry** for wood nailers, curbs, and blocking.
3. Division 7 Section "Asphalt Shingles" for installing sheet metal flashing and trim integral with roofing.
4. Division 7 Section "EPDM Roofing" for installing sheet metal flashing and trim integral with roofing membrane.
5. Division 7 Section "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
6. Division 7 Section "Joint Sealants" for field-applied sheet metal flashing and trim sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Fabricate and install **roof edge flashing** capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
1. Wind Zone 3: For velocity pressures of 46 to 104 lbf/sq. ft. (2.20 to 4.98 kPa): 208-lbf/sq. ft. (9.96-kPa) perimeter uplift force, 312-lbf/sq. ft. (14.94-kPa) corner uplift force, and 104-lbf/sq. ft. (4.98-kPa) outward force.

C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist

rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
4. Details of expansion-joint covers, including showing direction of expansion and contraction.

C. Samples for Initial Selection: For each type of sheet metal flashing and trim indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches (300 mm) long. Include fasteners, [**cleats,**] [**clips,**] closures, and other attachments.
2. Trim: 12 inches (300 mm) long. Include fasteners and other exposed accessories.
3. Accessories: Full-size Sample.

1.5 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

1. Copper Standard: Comply with CDA's "Copper in Architecture Handbook."

B. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof eave approximately 48 inches (1200 mm) long, including supporting construction cleats, seams, attachments and accessories.
2. Approval of mockups is for other material and construction qualities specifically approved by Architect in writing.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing and trim.
3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.7 COORDINATION

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 SHEET METALS

A. Copper Sheet: ASTM B 370, Temper H00 or H01, cold-rolled copper sheet.

B. Lead-Coated Copper Sheet: ASTM B 101, Temper H00 and H01, cold-rolled copper sheet, of weight (thickness) indicated below, coated both sides with lead weighing not less than 12 lb/100 sq. ft. (0.59 kg/sq. m) nor more than 15 lb/100 sq. ft. (0.73 kg/sq. m) of copper sheet (total weight of lead applied equally to both sides).

C. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003, 3004, 3105, or 5005, Temper suitable for forming and structural performance required, but not less than H14, finished as follows:

1. Mill Finish: **Standard one-side** bright.
2. Factory Prime Coating: Where painting after installation is indicated, provide pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat; with a minimum dry film thickness of 0.2 mil (0.005 mm).

3. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA **2604.**

        1) Color: **As selected by Architect from manufacturer's full range**.

4. Anodized Finish: Apply the following coil-anodized finish:

    a. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

        1) Color: **Dark bronze**.

D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

1. Finish: No. **2D (dull, cold rolled)**.

E. Zinc-Tin Alloy-Coated Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, dead-soft, fully annealed stainless-steel sheet, coated on both sides with a zinc-tin alloy (50 percent zinc, 50 percent tin).

1. Product: Subject to compliance with requirements, provide "TCS II" by Follansbee Steel.

F. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.

G. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.

H. Prepainted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
3. Exposed Finishes: Apply the following coil coating:

a. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1) Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements of AAMA **2604**, except as modified below:

a) Humidity Resistance: **2000** hours. Unless colors are preselected and specified or scheduled, retain one of three options in subparagraph below with finish selected above. Most manufacturers offer a variety of colors.

2) Color: **As selected by Architect from manufacturer's full range**.

I. Lead Sheet: ASTM B 749, Type L51121, copper-bearing lead sheet.

J. Zinc Sheet: Electrolytic, 99 percent pure zinc alloyed with 1 percent titanium and copper.

1. Finish: **Bright rolled**.

2.3 UNDERLAYMENT MATERIALS

A. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.

B. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

C. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Nails for Copper Sheet: Copper or hardware bronze, 0.109 inch (2.8 mm) minimum and not less than 7/8 inch (22 mm) long, barbed with large head.
2. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
3. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
4. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
5. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

C. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

D. Solder for Lead-Coated Copper: ASTM B 32, Grade Sn60, 60 percent tin and 40 percent lead.

E. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

F. Solder for Zinc-Tin Alloy-Coated Stainless Steel: ASTM B 32, 100 percent tin.

G. Solder for Lead: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

H. Solder for Zinc: ASTM B 32, 60 percent lead and 40 percent tin with low antimony, as recommended by manufacturer.

I. Burning Rod for Lead: Same composition as lead sheet.

J. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

K. Elastomeric Sealant: ASTM C 920, elastomeric **polyurethane** polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

L. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

M. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

N. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

O. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with **elastomeric** sealant concealed within joints.

F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing and Fascia Caps: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Furnish with 6-inch- (150-mm-) wide joint cover plates.

1. Joint Style: **Lap, 4 inches (100 mm) wide**.
2. Fabricate with scuppers spaced 10 feet (3 m) apart, of dimensions required with 4-inch- (100-mm-) wide flanges and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.

B. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, seal, and solder or weld watertight.

1. Joint Style: **Butt, with 12-inch- (300-mm-) wide concealed backup plate**.

C. **Roof and Roof to Wall Transition** Expansion-Joint Cover: Fabricate from the following material:
1. Aluminum: **0.050 inch (1.2 mm)** thick.

D. Base Flashing: Fabricate from the following material:
1. Aluminum: **0.050 inch (1.2 mm)** thick.

E. Counterflashing: Fabricate from the following material:

1. Copper: **16 oz./sq. ft. (0.55 mm thick).**
2. Lead-Coated Copper: **17.2 oz./sq. ft. (0.60 mm thick)**.
3. Aluminum: **0.0320 inch (0.8 mm)** thick.
4. Stainless Steel: **0.0187 inch (0.5 mm)** thick.

F. Flashing Receivers: Fabricate from the following material:

1. Copper: **16 oz./sq. ft. (0.55 mm thick)**.
2. Lead-Coated Copper: **17.2 oz./sq. ft. (0.60 mm thick)**.
3. Aluminum: **0.0320 inch (0.8 mm)** thick.
4. Stainless Steel: **0.0156 inch (0.4 mm)** thick.

G. Roof-Penetration Flashing: Fabricate from the following material:

1. Lead: **4.0 lb/sq. ft. (1.6 mm thick)**, hard tempered.
2. Copper: **16 oz./sq. ft. (0.55 mm thick)**.
3. Lead-Coated Copper: **17.2 oz./sq. ft. (0.60 mm thick)**.
4. Stainless Steel: **0.0187 inch (0.5 mm)** thick.

H. Roof-Drain Flashing: Fabricate from the following material:

1. Lead: **4.0 lb/sq. ft. (1.6 mm thick**, hard tempered.
2. Copper: **13.2 oz./sq. ft. (0.45 mm thick)**.
3. Lead-Coated Copper: [**12 oz./sq. ft. (0.4 mm thick)**.
4. Stainless Steel: [**0.0156 inch (0.4 mm)** thick.

2.7 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Drip Edges: Fabricate from the following material:

1. Aluminum: **0.0320 inch (0.8 mm)** thick.

B. Counterflashing: Fabricate from the following material:
1. Aluminum: **0.0320 inch (0.8 mm)** thick.

C. Roof-Penetration Flashing: Fabricate from the following material:

1. Lead: **4.0 lb/sq. ft. (1.6 mm thick)**, hard tempered.
2. Copper: **16 oz./sq. ft. (0.55 mm thick)**.
3. Lead-Coated Copper: **17.2 oz./sq. ft. (0.60 mm thick)**.
4.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following material:

1. Copper: **16 oz./sq. ft. (0.55 mm thick)**.
2. Lead-Coated Copper: **17.2 oz./sq. ft. (0.60 mm thick)**.
3. Stainless Steel: **0.0187 inch (0.5 mm** thick.
4. Galvanized Steel: [**0.0276 inch (0.7 mm)** thick.

2.9 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

1. Coat side of **uncoated aluminum**, **stainless-steel and lead** sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.
3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and **elastomeric** sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

1. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with **elastomeric** sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

1. Galvanized or Prepainted, Metallic-Coated Steel: Use stainless-steel fasteners.
2. Aluminum: Use aluminum or stainless-steel fasteners.
3. Copper Use copper or stainless-steel fasteners.
4. Stainless Steel: Use stainless-steel fasteners.

H. Seal joints with **elastomeric** sealant as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient

temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm) except where pretinned surface would show in finished Work.

1. Do not solder **prepainted, metallic-coated steel and aluminum** sheet.
2. Stainless-Steel Soldering: Pretin edges of uncoated sheets to be soldered using solder recommended for stainless steel and phosphoric acid flux. Promptly wash off acid flux residue from metal after soldering.
3. Copper Soldering: Tin uncoated copper surfaces at edges of sheets using solder recommended for copper work.
4. Where surfaces to be soldered are lead coated, do not tin edges, but wire brush lead coating before soldering.
5. Lead-Coated Copper Soldering: Wire brush edges of sheets before soldering.
6. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

J. Aluminum Flashing: Rivet or weld joints in uncoated aluminum where necessary for strength.

3.3 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.

1. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at **16-inch (400-mm)** centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.

1. Interlock exterior bottom edge of coping with continuous cleats anchored to substrate at **16-inch (400-mm)** centers.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for **elastomeric** sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with [**elastomeric**] [**butyl**] sealant.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:

1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.
2. Seal with **elastomeric** sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

3.4 MISCELLANEOUS FLASHING INSTALLATION

A. Overhead-Piping Safety Pans: Suspend pans from pipe and install drain line to plumbing waste or drain line.

B. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with **elastomeric** sealant to equipment support member.

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07620

SECTION 07720 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Roof curbs.
2. Equipment supports.
3. Roof hatches.
4. Snow guards.

B. Related Sections include the following:

1. Division 5 Section "Metal Fabrications" for ladders and miscellaneous metal framing and supports.
2. Division 6 Section "Rough Carpentry" for roof sheathing, wood cants, and wood nailers.
3. Division 6 Section "Wood Decking" for wooden roof decks.
4. Division 7 Sections for roofing accessories included as part of roofing Work.
5. Division 9 Section "Painting" for shop primers and field painting.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other Work.

C. Coordination Drawings: Roof plans drawn to scale and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.

D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for roof accessories with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples in manufacturer's standard sizes, and of same thickness and material indicated for the Work. If finishes involve normal color or shade variations, include sample sets showing the full range of variations expected.

1.4 QUALITY ASSURANCE

A. Standards: Comply with the following:

1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Roof Curbs and Equipment Supports:

a. AES Industries, Inc.
b. Colony Custom Curbs.
c. Commodity Products Company, Inc.
d. Conn-Fab Sales, Inc.
e. Curbs Plus, Inc.
f. Custom Curb, Inc.
g. Gieske Custom Metal Fabricators.
h. Goeller Enterprises.
i. LMCurbs.
j. Loren Cook Company.
k. Metallic Products Corporation.
l. Pate Co.(The).
m. Roof Products & Systems Corp.
n. ThyCurb, Inc.
o. Uni-Curb, Inc.
p. Vent Products Co., Inc.

2. Ridge Vents:

a. Air Vent, Inc.
b. Alcoa Building Products.
c. Commodity Products Company, Inc.
d. Cor-A-Vent, Inc.

e. GAF Materials Corporation.
f. Klauer Manufacturing Co.
g. Metallic Products Corporation.
h. Mid-America Building Products Corporation.
i. Niff-Corr, Inc.
j. Obdyke: Benjamin Obdyke, Inc.
k. Petersen Aluminum Corp.
l. Plyco Corporation.
m. Solar Group (The).
n. ThyCurb, Inc.
o. Trimco, Inc.
p. Trimline Roof Ventilation Systems.
q. Western Canwell.

3. Roof Hatches:

a. Babcock-Davis Hatchways, Inc.
b. Bilco Company.
c. Bristolite Skylights.
d. Custom Curb, Inc.
e. Dur-Red Products, Inc.
f. Goeller Enterprises.
g. Hi Pro International, Inc.
h. J. L. Industries, Inc.
i. Metallic Products Corporation.
j. Milcor, Inc.
k. Nystrom Products Co.
l. O'Keeffe's Inc.
m. Precision Stair Corporation.
n. Roof Products & Systems Corp.
o. ThyCurb, Inc,
p. Trimco, Inc.
q. Wasco Products, Inc.

2.2 MATERIALS, GENERAL

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M) for alclad alloy 3005H25 or alloy and temper required to suit forming operations, with mill finish, unless otherwise indicated.

B. Extruded Aluminum: ASTM B 221 (ASTM B 221M) alloy 6063-T52 or alloy and temper required to suit structural and finish requirements, with mill finish, unless otherwise indicated.

C. Galvanized Steel Sheet: ASTM A 653/A 653M with G90 (Z275) coating designation; commercial quality, unless otherwise indicated.

1. Structural Quality: Grade 40 (Grade 275), where indicated or as required for strength.

D. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M with Class AZ-50 (AZ-150) coating, structural quality, Grade 40 (Grade 275), or as required for strength.

E. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

F. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

1. Where removing exterior exposed fasteners affords access to building, provide nonremovable fastener heads.

G. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

H. Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coating.

I. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

J. Elastomeric Sealant: Generic type recommended by unit manufacturer that is compatible with joint surfaces; ASTM C 920, Type S, Grade NS, Class 25, and Uses NT, G, A, and, as applicable to joint substrates indicated, O.

K. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.3 ROOF CURBS

A. General: Provide roof curbs capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 0.0747-inch- (1.9-mm-) thick, structural-quality, hot-dip galvanized or aluminum-zinc alloy-coated steel sheet; factory primed and prepared for painting with welded or sealed mechanical corner joints.

1. Provide preservative-treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof.
2. Provide manufacturer's standard rigid or semirigid insulation where indicated.
3. Provide formed cants and base profile coordinated with roof insulation thickness.
4. Fabricate units to minimum height of 8 inches (200 mm), unless otherwise indicated.

2.4 EQUIPMENT SUPPORTS

A. General: Provide equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 0.063-inch- (1.6-mm-) thick, sheet aluminum with welded corner joints.

1. Provide preservative-treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof.
2. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
3. Fabricate units to minimum height of 8 inches (200 mm), unless otherwise indicated.
4. Sloping Roofs: Where slope of roof deck exceeds 1/4 inch per foot (1:48), fabricate support units with height tapered to match slope to level tops of units.

2.5 ROOF HATCHES

A. General: Fabricate units to withstand 40-lbf/sq. ft. (1.9- kPa) external and 20-lbf/sq. ft. (0.95-kPa) internal loading pressure. Frame with minimum 9-inch- (225-mm-) high, integral-curb, double-wall construction with 1-1/2-inch (38- mm) insulation, formed cants and cap flashing (roofing counterflashing), with welded or sealed mechanical corner joints. Provide double-wall cover (lid) construction with 1- inch- (25-mm-) thick insulation core. Provide gasketing and equip with corrosion-resistant or hot-dip galvanized hardware including pintle hinges, hold-open devices, interior padlock hasps, and both interior and exterior latch handles.

B. Type: Single-leaf personnel access.

1. For Ladder Access: 30 by 36 inches (750 by 900 mm).

C. Material: Aluminum, sheets and extrusions.
1. Finish: High-performance organic coating.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight.

a. For Spray Application: Comply with ASCA 96.
b. For Coil-Coated Sheets: Comply with AAMA 620.
c. Color and Gloss: As selected by Architect from manufacturer's full range.

2.8 GALVANIZED STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

B. High-Performance Organic Finish: Cleaned and primed with inhibitive primer and organic coating as specified below. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 621 for coil-coated sheets.
a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written instructions. Coordinate installation of roof accessories with installation of roof deck, roof insulation, flashing, roofing membranes, penetrations, equipment, and other construction involving roof accessories to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor roof accessories securely to supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.

B. Install roof accessory items according to construction details of NRCA's "Roofing and Waterproofing Manual," unless otherwise indicated,

C. Separation: Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.

D. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.

E. Cap Flashing: Where required as component of accessory, install cap flashing to provide waterproof overlap with roofing or roof flashing (as counterflashing). Seal overlap with thick bead of mastic sealant.

F. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

3.2 CLEANING AND PROTECTION

A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 07720

SECTION 07720 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Roof curbs.
2. Equipment supports.
3. Roof hatches.
4. Snow guards.

B. Related Sections include the following:

1. Division 5 Section "Metal Fabrications" for ladders and miscellaneous metal framing and supports.
2. Division 6 Section "Rough Carpentry" for roof sheathing, wood cants, and wood nailers.
3. Division 6 Section "Wood Decking" for wooden roof decks.
4. Division 7 Sections for roofing accessories included as part of roofing Work.
5. Division 9 Section "Painting" for shop primers and field painting.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other Work.

C. Coordination Drawings: Roof plans drawn to scale and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.

D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for roof accessories with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples in manufacturer's standard sizes, and of same thickness and material indicated for the Work. If finishes involve normal color or shade variations, include sample sets showing the full range of variations expected.

1.4 QUALITY ASSURANCE

A. Standards: Comply with the following:

1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Roof Curbs and Equipment Supports:

a. AES Industries, Inc.
b. Colony Custom Curbs.
c. Commodity Products Company, Inc.
d. Conn-Fab Sales, Inc.
e. Curbs Plus, Inc.
f. Custom Curb, Inc.
g. Gieske Custom Metal Fabricators.
h. Goeller Enterprises.
i. LMCurbs.
j. Loren Cook Company.
k. Metallic Products Corporation.
l. Pate Co.(The).
m. Roof Products & Systems Corp.
n. ThyCurb, Inc.
o. Uni-Curb, Inc.
p. Vent Products Co., Inc.

2. Ridge Vents:

a. Air Vent, Inc.
b. Alcoa Building Products.
c. Commodity Products Company, Inc.
d. Cor-A-Vent, Inc.

e. GAF Materials Corporation.
f. Klauer Manufacturing Co.
g. Metallic Products Corporation.
h. Mid-America Building Products Corporation.
i. Niff-Corr, Inc.
j. Obdyke: Benjamin Obdyke, Inc.
k. Petersen Aluminum Corp.
l. Plyco Corporation.
m. Solar Group (The).
n. ThyCurb, Inc.
o. Trimco, Inc.
p. Trimline Roof Ventilation Systems.
q. Western Canwell.

3. Roof Hatches:

a. Babcock-Davis Hatchways, Inc.
b. Bilco Company.
c. Bristolite Skylights.
d. Custom Curb, Inc.
e. Dur-Red Products, Inc.
f. Goeller Enterprises.
g. Hi Pro International, Inc.
h. J. L. Industries, Inc.
i. Metallic Products Corporation.
j. Milcor, Inc.
k. Nystrom Products Co.
l. O'Keeffe's Inc.
m. Precision Stair Corporation.
n. Roof Products & Systems Corp.
o. ThyCurb, Inc,
p. Trimco, Inc.
q. Wasco Products, Inc.

2.2 MATERIALS, GENERAL

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M) for alclad alloy 3005H25 or alloy and temper required to suit forming operations, with mill finish, unless otherwise indicated.

B. Extruded Aluminum: ASTM B 221 (ASTM B 221M) alloy 6063-T52 or alloy and temper required to suit structural and finish requirements, with mill finish, unless otherwise indicated.

C. Galvanized Steel Sheet: ASTM A 653/A 653M with G90 (Z275) coating designation; commercial quality, unless otherwise indicated.

1. Structural Quality: Grade 40 (Grade 275), where indicated or as required for strength.

D. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M with Class AZ-50 (AZ-150) coating, structural quality, Grade 40 (Grade 275), or as required for strength.

E. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

F. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

1. Where removing exterior exposed fasteners affords access to building, provide nonremovable fastener heads.

G. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

H. Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coating.

I. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

J. Elastomeric Sealant: Generic type recommended by unit manufacturer that is compatible with joint surfaces; ASTM C 920, Type S, Grade NS, Class 25, and Uses NT, G, A, and, as applicable to joint substrates indicated, O.

K. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.3 ROOF CURBS

A. General: Provide roof curbs capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 0.0747-inch- (1.9-mm-) thick, structural-quality, hot-dip galvanized or aluminum-zinc alloy-coated steel sheet; factory primed and prepared for painting with welded or sealed mechanical corner joints.

1. Provide preservative-treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof.
2. Provide manufacturer's standard rigid or semirigid insulation where indicated.
3. Provide formed cants and base profile coordinated with roof insulation thickness.
4. Fabricate units to minimum height of 8 inches (200 mm), unless otherwise indicated.

2.4 EQUIPMENT SUPPORTS

A. General: Provide equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 0.063-inch- (1.6-mm-) thick, sheet aluminum with welded corner joints.

1. Provide preservative-treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof.
2. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
3. Fabricate units to minimum height of 8 inches (200 mm), unless otherwise indicated.
4. Sloping Roofs: Where slope of roof deck exceeds 1/4 inch per foot (1:48), fabricate support units with height tapered to match slope to level tops of units.

2.5 ROOF HATCHES

A. General: Fabricate units to withstand 40-lbf/sq. ft. (1.9- kPa) external and 20-lbf/sq. ft. (0.95-kPa) internal loading pressure. Frame with minimum 9-inch- (225-mm-) high, integral-curb, double-wall construction with 1-1/2-inch (38- mm) insulation, formed cants and cap flashing (roofing counterflashing), with welded or sealed mechanical corner joints. Provide double-wall cover (lid) construction with 1- inch- (25-mm-) thick insulation core. Provide gasketing and equip with corrosion-resistant or hot-dip galvanized hardware including pintle hinges, hold-open devices, interior padlock hasps, and both interior and exterior latch handles.

B. Type: Single-leaf personnel access.

1. For Ladder Access: 30 by 36 inches (750 by 900 mm).

C. Material: Aluminum, sheets and extrusions.
1. Finish: High-performance organic coating.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight.

a. For Spray Application: Comply with ASCA 96.
b. For Coil-Coated Sheets: Comply with AAMA 620.
c. Color and Gloss: As selected by Architect from manufacturer's full range.

2.8 GALVANIZED STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

B. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply the air-dried primer specified below immediately after cleaning and pretreating.

1. Shop Primer: Exterior galvanized metal primer per Division 9 Section "Painting."

C. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

D. High-Performance Organic Finish: Cleaned and primed with inhibitive primer and organic coating as specified below. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 621 for coil-coated sheets.
2. Fluoropolymer Three-Coat System: Manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 621 for coil-coated sheets.

a. Color and Gloss: As indicated by manufacturer's designations.
b. Color and Gloss: Match Architect's sample.

c. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written instructions. Coordinate installation of roof accessories with installation of roof deck, roof insulation, flashing, roofing membranes, penetrations, equipment, and other construction involving roof accessories to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor roof accessories securely to supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.

B. Install roof accessory items according to construction details of NRCA's "Roofing and Waterproofing Manual," unless otherwise indicated,

C. Separation: Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.

D. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.

E. Cap Flashing: Where required as component of accessory, install cap flashing to provide waterproof overlap with roofing or roof flashing (as counterflashing). Seal overlap with thick bead of mastic sealant.

F. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

G. Heat-and-Smoke Vents: Locate, install, and test according to NFPA 204M.

H. Ridge Vents: Install according to manufacturer's written instructions.

I. Snow Guards: Install according to written installation instructions and recommendations of manufacturer and NRCA's "Steep Roofing Manual." Unless otherwise indicated, locate snow guards at 18 inches (450 mm) o.c. horizontally, and at every other course vertically, beginning 24 inches (600 mm) up from gutter. Stagger snow guard location by 9 inches (225 mm) between courses.

3.2 CLEANING AND PROTECTION

A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 07720

SECTION 078413

THROUGH-PENETRATION FIRESTOP SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:
   1. Floors.
   2. Roofs.
   3. Walls and partitions.
   4. Smoke barriers.
   5. Construction enclosing compartmentalized areas.

B. Related Sections include the following:
   1. Division 3 Section "Cast-in-Place Concrete" for construction of openings in concrete slabs and walls.
   2. Division 7 Section "Building Insulation" for safing insulation and accessories.
   3. Division 7 Section "Fire-Resistive Joint Systems."
   4. Division 15 Sections specifying duct and piping penetrations, including fire-suppression piping. Firestopping is included as part of Division 15 filed sub-bids.
   5. Division 16 Sections specifying cable and conduit penetrations. Firestopping is included as part of Division 16 filed sub-bid.

1.03 PERFORMANCE REQUIREMENTS

A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.
   1. Fire-resistance-rated load-bearing walls, including partitions, with fire-protection-rated openings.
   2. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
   3. Fire-resistance-rated floor assemblies.
   4. Fire-resistance-rated roof assemblies.

B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

1. Penetrations located outside wall cavities.
2. Penetrations located outside fire-resistive shaft enclosures.
3. Penetrations located in construction containing fire-protection-rated openings.
4. Penetrating items larger than 4-inch- diameter nominal pipe or 16 sq. in. in overall cross-sectional area.

D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.
1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
4. Products in public areas shall be paintable.

E. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

F. Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings indicated, as determined per UL 2079, but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.

1.04 SUBMITTALS

A. General: Submit in accordance with Section 01330.

B. Product Data: For each type of through-penetration firestop system product indicated. List product characteristics, typical uses, performance and limitation criteria, and test data.
1. Include manufacture's installation procedures for each type of product.

C. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Indicate which firestop materials will be used where and thickness for different hourly ratings. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.
1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
3. For those firestop applications that exist for which no UL tested system is available through a manufacturer, manufacturer's engineering judgement derived from similar UL system design or other tests shall be submitted to local authorities having jurisdiction for their review and approval prior to installation. Manufacturer's engineering judgement shall follow the requirements set forth by the International Firestop Council.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.

F. Product Test Reports: From an independent qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An experienced Installer who has completed through-penetration firestop systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:
   1. Firestopping tests shall be performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, Warnock Hersey, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
   2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:
      a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
      b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
         1) UL in "Fire Resistance Directory."
         2) ITS in "Directory of Listed Products."

D. Provide through-penetration firestop system products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, subpart F, Appendix A, Section 1, "Polarized Light Microscopy."

E. Field-Testing: Each type of through-penetration firestop system shall be field-tested.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multi-component materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.08 COORDINATION

A. Coordinate the Work of this Section with the work of other trades to assure the proper sequencing of each installation and to provide a smoke- and fire-resistant installation.

B. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

C. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

D. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

E. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bio Fireshield, Carlisle, MA.
2. W. R. Grace & Co., Construction Products Division.
3. Hilti Construction Chemicals, Inc.
4. Isolatek International.
5. Nelson Firestop Products.
6. Specified Technologies Inc.
7. 3M Fire Protection Products.

2.02 FIRESTOPPING, GENERAL

A. Firestop Systems: All firestop products and systems shall be designed and installed so that the basic sealing system will allow the full restoration of the thermal and fire-resistance properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed.
1. Provide paintable firestop products at locations exposed to the public. Mechanical, electrical and elevator machine rooms are not considered public spaces.

B. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

C. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
   1. Permanent forming/damming/backing materials, including the following:
      a. Slag-/rock-wool-fiber insulation.
      b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
      c. Fire-rated form board.
      d. Fillers for sealants.
   2. Temporary forming materials.
   3. Substrate primers.
   4. Collars.
   5. Steel sleeves.

2.03 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the UL or Warnock Hersey tested assembly.

B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
   1. Product:
      a. CP 680 Cast-In-Place Firestop Device; Hilti Construction Chemicals, Inc.

C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
   1. Product:
      a. Biostop 500+ Intumescent Firestop; Bio Fireshield.
      b. FlameSafe FS900 Sealant; W. R. Grace & Co.
      c. Fire Barrier CP 25WB+; 3M Fire Protection Products.
      d. SpecSeal LC 150 Sealant; Specified Technologies Inc.

D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
   1. Product:
      a. Biostop Pipe Collar; Bio Fireshield.
      b. FlameSafe FSWS Series FlameSafe Devices; W. R. Grace & Co.
      c. CP 642 and CP 643 Firestop Jacket; Hilti Construction Chemicals, Inc.
      d. SpecSeal Series LCC and Series SSC Firestop Collars; Specified Technologies Inc.

E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
   1. Product:

a. Biostop Composite Sheet; Bio Fireshield.
b. CS-195 Composite Sheet; 3M Fire Protection Products.

F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
1. Product:
a. FlameSafe FSP 1000 Putty and FSP 1077 Putty Pads; W. R. Grace & Co.
b. CP 617 and CP 618 Putty Pads and Putty Sticks; Hilti Construction Chemicals, Inc.
c. MPS-2 Moldable Putty Stix and Putty Pads; 3M Fire Protection Products.
d. Spec-Seal Firestop Putty Bars and Putty Pads; Specified Technologies Inc.

G. Intumescent Wrap Strips with Foil: Single-component intumescent elastomeric sheets with aluminum foil on one side.
1. Product:
a. CP 645 Wrap Strips; Hilti Construction Chemicals, Inc.
b. Fire Barrier FS-195+ Wrap Strip; 3M Fire Protection Products.

H. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets.
1. Product:
a. Biostop Wrap Strip; Bio Fireshield.
b. SpecSeal Series SSWBLU and Series SSWRED Intumescent Wrap; Specified Technologies Inc.

I. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
1. Product:
a. FlameSafe Mortar Safe; W. R. Grace & Co.
b. CP 636 Firestop Mortar; Hilti Construction Chemicals, Inc.
c. SpecSeal Firestop Mortar; Specified Technologies Inc.

J. Pillows/Bags: Reusable, heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.
1. Product:
a. Bio Firestop Pillows; Bio Fireshield.
b. FlameSafe Bags and FlameSafe Pillows; W. R. Grace & Co.
c. CP 651 Firestop Cushion; Hilti Construction Chemicals, Inc.
d. SpecSeal Firestop Pillows; Specified Technologies Inc.

K. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
1. Product:
a. CP 620 Firestop Foam; Hilti Construction Chemicals, Inc.
b. Fire Barrier 2001 Silicone RTV Foam; 3M Fire Protection Products.
c. SpecSeal Pen 200 Silicone Foam; Specified Technologies Inc.

L. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a

nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

a. Product:
   1) Biotherm 200SL Firestop Sealant; Bio Fireshield.
   2) CP 604 Self-Leveling Firestop Sealant; Hilti Construction Chemicals, Inc.
   3) Fire Barrier 1003SL; 3M Fire Protection Products.
   4) SpecSeal Pen 300 Silicone Sealant; Specified Technologies Inc.

2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
   a. Product:
      1) Biotherm 200SL Firestop Sealant; Bio Fireshield.
      2) CP 604 Self-Leveling Firestop Sealant; Hilti Construction Chemicals, Inc.
      3) Fire Barrier 1003SL; 3M Fire Protection Products.
3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.
   a. Product:
      1) Biotherm 100 Firestop Sealant; Bio Fireshield.
      2) CP 601S Elastomeric Firestop Sealant; Hilti Construction Chemicals, Inc.

M. Accessories: Forming/damming materials composed of mineral fiberboard or other type as recommended by through-penetration firestop systems manufacturer.

2.04 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.03 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner may engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports.
1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.

B. Allow for 3 random samples of each type of firestopping system to be inspected. Reinstall disturbed samples to comply with requirements.

C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.

D. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.05 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

END OF SECTION 07841

SECTION 07920

JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:
   1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
      a. Construction and control joints in cast-in-place concrete.
      b. Joints between architectural precast concrete units and between architectural precast concrete units and adjacent materials.
      c. Control and expansion joints in unit masonry.
      d. Joints between metal panels.
      e. Joints between different materials listed above.
      f. Perimeter joints between materials listed above and frames of doors, windows and louvers.
      g. Control joints in ceilings and other overhead surfaces.
      h. Other joints as indicated.
   2. Exterior joints in the following horizontal traffic surfaces:
      a. Isolation and contraction joints in cast-in-place concrete slabs.
      b. Other joints as indicated.
   3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints of exterior openings where indicated.
      c. Tile control and expansion joints.
      d. Vertical joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
      e. Joints on underside of plant-precast structural concrete planks.
      f. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
      g. Joints between plumbing fixtures and adjoining walls, floors, and counters.
      h. Other joints as indicated.
   4. Interior joints in the following horizontal traffic surfaces:
      a. Isolation and control joints in exposed cast-in-place concrete slabs.
      b. Control and expansion joints in tile flooring.
      c. Other joints as indicated.

B. Related Sections include the following:
   1. Division 2 Sections for sealing joints in pavements, walkways, and curbing.
   2. Division 4 Section "Unit Masonry Assemblies" for masonry control and expansion joint fillers and gaskets.
   3. Division 7 Section "Sheet Metal Flashing and Trim" for sealing joints related to flashing.
   4. Division 7 Section "Through-Penetration Firestop Systems" for sealing penetrations in fire-resistance-rated construction.
   5. Division 7 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
   6. Division 8 Section "Glazing" for glazing sealants.
   7. Division 9 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.

8. Division 9 Section "Ceramic Tile" for sealing tile joints.
9. Divisions 15 and 16 for sealing of perimeter joints of plumbing, HVAC systems, automatic fire protection systems, telecommunication systems, and electrical systems.

1.03 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that have been produced and installed to establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.04 SUBMITTALS

A. General: Submit in accordance with Section 01330.

B. Product Data: For each joint-sealant product indicated.

C. Samples for Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Qualification Data: For Installer.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in materials, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, shelf/pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

C. Remove and replace materials, at no cost to Owner, that cannot be applied within their stated shelf life.

1.07 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.08 SEQUENCING AND SCHEDULING

A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation to ensure a weathertight installation.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.02 JOINT SEALANTS

A. Type 1 - General Purpose Exterior Sealant: Polyurethane; ASTM C920, Type S, Grade NS, Class 25; single component.
1. Sonolastic NP-1; Sonneborn, Division of ChemRex Inc.
2. Dymonic; Tremco, Inc.
3. Sikaflex-1a; Sika Corporation, Inc.
4. Dynatrol 1; Pecora Corporation.
5. Vulkem 116; Tremco, Inc.
6. Chem-Calk 900; Bostik Findley.

B. Type 2 - General Purpose Exterior Sealant: Polyurethane; ASTM C920, Type M, Grade NS, Class 25; two-component.
1. Sonolastic NP-2; Sonneborn, Division of ChemRex Inc.
2. Dymeric 240/240FC; Tremco, Inc.
3. Sikaflex-2c, NS; Sika Corporation, Inc.
4. Dynatrol 2; Pecora Corporation.
5. Vulkem 922; Tremco, Inc.
6. Chem-Calk 500; Bostik Findley.

C. Type 3 - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, single component, paintable.
1. Tremflex 834; Tremco, Inc.
2. AC-20; Pecora Corporation.
3. Chem-Calk 600; Bostik Findley.

D. Type 4 - Plumbing Fixture/Tile Sealant: Silicone; ASTM C920, Uses M and A; single component, mildew resistant, color selected by Architect.
1. Sanitary SCS 1700; GE Silicones.
2. 898 Silicone; Pecora Corporation.
3. 786 MR Silicone; Dow Corning Corporation.
4. Tremsil 200; Tremco, Inc.

E. Type 5 - Acoustical Sealant: Specified in Section 09260.

F. Type 6 - Interior Floor Joint Sealant: Polyurethane, self-leveling; ASTM C920, Grade P, Class 25, Uses T, M and A; single component.

1. Sonolastic SL-1; Sonneborn, Division of ChemRex Inc.
2. Sikaflex-1CSL; Sika Corporation, Inc.
3. Vulkem 45/45SSL; Tremco, Inc.

2.03 JOINT-SEALANT BACKING

A. General: Provide sealant backings (backer rods) of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers (Backer Rods): Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
1. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.04 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean concrete, masonry unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint

sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.

3. Remove laitance and form-release agents from concrete.
4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates, where indicated or recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Installation of Sealant Backings (Backer Rods): Install sealant backings to comply with the following requirements:

1. Install sealant backings of type indicated to provide support of sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   a. Do not leave gaps between ends of joint fillers.
   b. Do not stretch, twist, puncture, or tear joint fillers.
2. Install bond-breaker tape behind sealants where sealant backings (backer rods) are not used between sealants and backs of joints.

D. Installation of Sealants: Install sealants using proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.04 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.06 JOINT-SEALANT SCHEDULE

A. Control, Expansion, and Soft Joints in Masonry and Between Masonry and Adjacent Work: Type 2; colors as selected.

B. Exterior Joints Between Precast Concrete Units: Type 2; colors as selected.

C. Joints between Exterior Metal Frames and Adjacent Work (Except Masonry): Type 2; colors as selected.

D. Under Exterior Door Thresholds: Type 1.

E. Exterior Joints for Which No Other Sealant Type is Indicated: Type 2; colors as selected.

F. Concealed Interior Perimeter Joints of Exterior Openings: Type 1.

G. Exposed Interior Perimeter Joints of Exterior Openings: Type 3; colors as selected.

H. Interior Ceramic Tile Expansion, Control, Contraction, and Isolation Joints in Horizontal Traffic Surfaces: Type 2; color as selected.

I. Control and Expansion Joints in Interior Concrete Slabs and Floors Left Exposed: Type 6; colors as selected.

J. Joints between Plumbing Fixtures and Walls and Floors and Between Countertops and Walls: Type 4; colors as selected.

K. Interior Joints for Which No Other Sealant is Indicated: Type 3; colors as selected.

END OF SECTION 07920

SECTION 081100

STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. See LEED for New Construction Version 2.2 Reference Guide and Section 018113 – Sustainable Design Requirements. Targeted LEED Credits:

LEED MR Credit 2.1 – Recycle and/or salvage at least 50% of non-hazardous construction and demolition debris.
LEED MR Credit 2.2 – Recycle and/or salvage an additional 25% beyond MR Credit 2.1 (referenced above) for a total of at least 75% of non-hazardous construction and demolition debris.
LEED MR 4.1 – This credit requires the use of materials with recycled content such that the sum of post-consumer recycled content plus one-half of the post-industrial content constitutes at least 10% (based on cost) of the total value of the materials in the project.
LEED MR 4.2 – This credit requires the use of materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes an additional 10% beyond MR Credit 4.1 (referenced above) for a total of 20% (based on cost) of the total value of the materials in the project.

1.02 SUMMARY

A. This Section includes steel doors and steel frames.

B. Related Sections include the following:
1. Division 1 Section "Sustainable Design Requirements"
2. Division 4 Section "Unit Masonry Assemblies" for building anchors into and grouting steel frames in masonry construction.
3. Division 8 Section "Glazing" for glazed lites in steel doors and frames.
4. Division 8 Sections for door hardware and weatherstripping for steel doors.
5. Division 9 painting Sections for field painting steel doors and frames.
6. Division 16 for electrical service and connections of electrified door hardware and controls.

1.03 DEFINITIONS

A. Minimum Steel Sheet Thickness: Minimum thickness of base metal without coatings.

1.04 SUBMITTALS

A. General: Submit in accordance with Section 013300.
1. Submittals for Sections 081100, 082110, and 087100 shall be made concurrently.

B. Product Data: Include door designation, type, level and model, construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, and finishes for each type of steel door and frame specified.

C. Shop Drawings: In addition to requirements below, provide a schedule of steel doors and frames using same reference numbers for details and openings as those on Drawings:
   1. Elevations of each door design.
   2. Details of doors, including vertical and horizontal edge details.
   3. Frame details for each frame type, including dimensioned profiles.
   4. Details and locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of anchorages, accessories, joints, and connections.
   7. Details of glazing frames and stops showing glazing.
   8. Details of conduit and preparations for electrified door hardware and controls.

D. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.

E. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of steel door and frame.

F. Material Certificates: Signed by manufacturers certifying that each fire-rated door complies with requirements.

G. LEED-Required Submittals per Division 1 Section 018113.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain steel doors and frames through one source from a single manufacturer.

B. Fire-Rated Door Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.
   1. Test Pressure: Test at atmospheric (neutral) pressure according to NFPA 252 or UL 10B.
      a. Location: CMCC.
   2. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches or less above the sill.
      a. Location: EMCC and SMCC.

C. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Inspect doors and frames on delivery for damage; notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.

D. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.
   1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.07 COORDINATION

A. Coordinate installation of anchorages for steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ceco Door Products; a United Dominion Company.
2. CURRIES Company; an ASSA ABLOY Group Company.
3. Steelcraft; an Ingersoll-Rand Company.

2.02 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653, Commercial Steel (CS), Type B; with minimum A40 zinc-iron-alloy (galvannealed) coating designation.

D. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153, Class B.

E. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153.

F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching standard steel door frames of type indicated.

G. Grout: Comply with Division 4 Section "Unit Masonry Assemblies."

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Comply with requirements in Division 8 Section "Glazing."

J. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.03 STEEL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8, unless more stringent requirements are specified.

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board with internal sound deadener on inside of face sheets, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.
   a. Fire Door Core: As required to provide fire-protection ratings indicated.
   b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 11.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363, unless otherwise indicated.
      1) Locations: Exterior doors.
3. Vertical Edges for Doors: Beveled edge.
   a. Beveled Edge: 1/8 inch in 2 inches.
4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick end closures or channels of same material as face sheets.
5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior door requirements. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).

D. Hardware Reinforcement: Fabricate reinforcement plates of sufficient strength from same material as door face sheets to support hardware without through bolting and to comply with the following minimum sizes:
1. Hinges: Minimum 0.123 inch thick (10 gage) by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
2. Pivots: Minimum 0.167 inch thick (8 gage) by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
3. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch thick (8 gage).
4. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick (8 gage).

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.04 STEEL FRAMES

A. General: Comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.
1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
2. Frames for Level 3 Steel Doors: 0.067-inch- thick (14 gage) steel sheet, unless otherwise indicated.

C. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.
1. Fabricate frames with mitered or coped and welded face corners and seamless face joints for pairs of doors.
2. Fabricate knocked-down frames with mitered or coped corners at single leaf door openings, for field assembly.
3. Frames for Level 2 Steel Doors: 0.053-inch- thick (16 gage) steel sheet, unless otherwise indicated.
4. Frames for Wood Doors: 0.053-inch- thick (16 gage) steel sheet, unless otherwise indicated.

5. Frames for Borrowed Lights: 0.042-inch- thick (18 gage) steel sheet, unless otherwise indicated.
6. All welded joints shall be ground and dressed to be smooth, flush, and invisible.

D. Hardware Reinforcement: Fabricate reinforcement plates of sufficient strength from same material as frames to support hardware without through bolting and to comply with the following minimum sizes:
1. Hinges: Minimum 0.123 inch thick (10 gage) by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
2. Pivots: Minimum 0.167 inch thick (8 gage) by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
3. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch thick (14 gage).
4. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick (14 gage).
5. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

E. Supports and Anchors: Fabricated from not less than 0.042-inch thick (18 gage) electrolytic zinc-coated or metallic-coated steel sheet.

F. Jamb Anchors:
1. Masonry Type: T-shaped anchors to suit frame size, not less than 0.042 inch thick (18 gage).
2. Metal Stud-Wall Type: Slip in wood stud anchor equal to Curries M series; not less than 0.053 inch thick (16 gage).

G. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick (18 gage), and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

H. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

I. Plaster Guards: Formed from same material as frames, not less than 0.016-inch thick (28 gage) steel sheet to close off interior of openings; place at back of hardware cutouts where mortar or other materials might obstruct hardware operation.

2.05 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick (20 gage), fabricated from same material as door face sheet in which they are installed.
1. Provide non-removable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
2. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.

B. Fixed Frame Moldings: Formed integral with steel frames, minimum 5/8 inch high, unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick (20 gage), fabricated from same material as frames in which they are installed.

D. Astragals: As required by NFPA 80 to provide fire ratings indicated.

2.06 FABRICATION

A. General: Fabricate steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Steel Doors:

1. Exterior Doors: For exterior locations and elsewhere as indicated, fabricate doors, panels, and frames from metallic-coated steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 0.053-inch-thick (16 gage), metallic-coated steel channels with channel webs placed even with top and bottom edges. Seal joints in top edges of doors against water penetration.
2. Interior Door and Panel Faces: Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from cold-rolled steel sheet, unless otherwise indicated.
3. Pairs of Doors: Size of pairs of doors to provide maximum 3/16-inch gap between leafs to permit proper functioning of dead latching feature.
4. Glazed Lites: Factory cut openings in doors.

C. Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints; fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding; grind smooth and invisible.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
4. Plaster Guards: Weld guards to frame at back of hardware mortises in frames installed in concrete or masonry.
5. Where installed in masonry, leave vertical mullions in frames open at top for grouting.
6. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor. Provide floor anchors for all frames.
7. Jamb Anchors: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
    a. Masonry Type:
        1) Two anchors per jamb up to 60 inches in height.
        2) Three anchors per jamb from 60 to 90 inches in height.
        3) Four anchors per jamb from 90 to 120 inches in height.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof more than 120 inches in height.

    b. Stud-Wall Type:
        1) Three anchors per jamb up to 60 inches in height.
        2) Four anchors per jamb from 60 to 90 inches in height.
        3) Five anchors per jamb from 90 to 96 inches in height.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in height.
        5) Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
8. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
9. Provide welded frames with temporary spreader bars for shipping.

D. Hardware Preparation: Factory prepare standard steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
1. Reinforce doors and frames to receive nontemplated mortised and surface-mounted door hardware. Through bolting will not be acceptable.
2. Comply with applicable requirements in ANSI A250.6 and ANSI/DHI A115 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of door or frame.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings such that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of doors and frames.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

F. Astragals: As required by NFPA 80 to provide fire ratings indicated.

2.07 STEEL FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Apply primers to steel doors and frames after assembly.

B. Comply with SSPC-PA1, "Paint Application Specification No. 1," for steel sheet finishes.

C. Metallic-Coated Steel Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

D. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

E. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of steel doors and frames.
1. Examine roughing-in for embedded and built-in anchors to verify actual locations of steel frame connections before frame installation.
2. If unacceptable conditions are encountered, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove welded-in shipping spreaders installed at factory.

B. Paint backside of frames to be set in masonry with bituminous coating.

C. Prior to installation, adjust and securely brace steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

D. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.03 INSTALLATION

A. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Steel Frames: Install standard steel frames for doors, sidelights, transoms, borrowed lights, and other openings, of size and profile indicated. Comply with SDI 105.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
   a. At fire-protection-rated openings, install frames according to NFPA 80.
   b. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   c. Install frames with removable glazing stops located on secure side of opening.
   d. Install door silencers in frames before grouting.
   e. Remove shipping straps at bottom of frames. Properly space frame using wood template that is full depth of frame and of proper spacing width during setting and anchoring of frames to maintain proper width, with frame plumb and square without twists. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   f. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   g. Apply bituminous coating to backs of frames that are filled with mortar, grout, and plaster.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors. Floor anchors are in addition to wall anchors.
   a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Metal-Stud Partitions: Attach wall anchors to studs with screws. Provide floor anchor at each jamb, in addition to the wall anchors.
4. Masonry Walls: Anchors shall be masonry T-shaped anchors. Provide floor anchor at each jamb, in addition to the wall anchors. Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division 4 Section "Unit Masonry Assemblies."
5. Installation Tolerances: Adjust steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

6. Mineral Fiber Insulation: Fill head and jambs of frames scheduled to receive sound seals with mineral fiber insulation.

C. Steel Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.
4. Pairs of Doors: Install pairs of doors to provide maximum 3/16-inch gap between leafs and accurate alignment of strike to permit proper functioning of dead latching feature.

D. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with steel door and frame manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c., and not more than 2 inches o.c. from each corner.

3.04 ADJUSTING AND CLEANING

A. Final Adjustments: Remove and replace defective work, including steel doors or frames that are warped, bowed, or otherwise unacceptable.

B. Clean grout and other bonding material off steel doors and frames immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

END OF SECTION 08110

SECTION 08110

STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes steel doors and steel frames.

B. Related Sections include the following:
1. Division 4 Section "Unit Masonry Assemblies" for building anchors into and grouting steel frames in masonry construction.
2. Division 8 Section "Glazing" for glazed lites in steel doors and frames.
3. Division 8 Sections for door hardware and weatherstripping for steel doors.
4. Division 9 painting Sections for field painting steel doors and frames.
5. Division 16 for electrical service and connections of electrified door hardware and controls.

1.03 DEFINITIONS

A. Minimum Steel Sheet Thickness: Minimum thickness of base metal without coatings.

1.04 SUBMITTALS

A. General: Submit in accordance with Section 01330.
1. Submittals for Sections 08110, 08211, and 08710 shall be made concurrently.

B. Product Data: Include door designation, type, level and model, construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, and finishes for each type of steel door and frame specified.

C. Shop Drawings: In addition to requirements below, provide a schedule of steel doors and frames using same reference numbers for details and openings as those on Drawings:
1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details.
3. Frame details for each frame type, including dimensioned profiles.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, accessories, joints, and connections.
7. Details of glazing frames and stops showing glazing.
8. Details of conduit and preparations for electrified door hardware and controls.

D. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.

E. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of steel door and frame.

F. Material Certificates: Signed by manufacturers certifying that each fire-rated door complies with requirements.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain steel doors and frames through one source from a single manufacturer.

B. Fire-Rated Door Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.
   1. Test Pressure: Test at atmospheric (neutral) pressure according to NFPA 252 or UL 10B.
      a. Location: CMCC.
   2. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches or less above the sill.
      a. Location: EMCC and SMCC.

C. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Inspect doors and frames on delivery for damage; notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.

D. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.
   1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.07 COORDINATION

A. Coordinate installation of anchorages for steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ceco Door Products; a United Dominion Company.
   2. CURRIES Company; an ASSA ABLOY Group Company.
   3. Steelcraft; an Ingersoll-Rand Company.

2.02 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653, Commercial Steel (CS), Type B; with minimum A40 zinc-iron-alloy (galvannealed) coating designation.

D. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153, Class B.

E. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153.

F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching standard steel door frames of type indicated.

G. Grout: Comply with Division 4 Section "Unit Masonry Assemblies."

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Comply with requirements in Division 8 Section "Glazing."

J. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.03 STEEL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8, unless more stringent requirements are specified.
   1. Design: Flush panel.
   2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board with internal sound deadener on inside of face sheets, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.
      a. Fire Door Core: As required to provide fire-protection ratings indicated.
      b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 11.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363, unless otherwise indicated.
         1) Locations: Exterior doors.
   3. Vertical Edges for Doors: Beveled edge.
      a. Beveled Edge: 1/8 inch in 2 inches.
   4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick end closures or channels of same material as face sheets.
   5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
   1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior door requirements. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
   1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).

D. Hardware Reinforcement: Fabricate reinforcement plates of sufficient strength from same material as door face sheets to support hardware without through bolting and to comply with the following minimum sizes:
   1. Hinges: Minimum 0.123 inch thick (10 gage) by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
   2. Pivots: Minimum 0.167 inch thick (8 gage) by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
   3. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch thick (8 gage).
   4. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick (8 gage).

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.04 STEEL FRAMES

A. General: Comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.
   1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
   2. Frames for Level 3 Steel Doors: 0.067-inch- thick (14 gage) steel sheet, unless otherwise indicated.

C. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.
   1. Fabricate frames with mitered or coped and welded face corners and seamless face joints for pairs of doors.
   2. Fabricate knocked-down frames with mitered or coped corners at single leaf door openings, for field assembly.
   3. Frames for Level 2 Steel Doors: 0.053-inch- thick (16 gage) steel sheet, unless otherwise indicated.
   4. Frames for Wood Doors: 0.053-inch- thick (16 gage) steel sheet, unless otherwise indicated.
   5. Frames for Borrowed Lights: 0.042-inch- thick (18 gage) steel sheet, unless otherwise indicated.
   6. All welded joints shall be ground and dressed to be smooth, flush, and invisible.

D. Hardware Reinforcement: Fabricate reinforcement plates of sufficient strength from same material as frames to support hardware without through bolting and to comply with the following minimum sizes:
   1. Hinges: Minimum 0.123 inch thick (10 gage) by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
   2. Pivots: Minimum 0.167 inch thick (8 gage) by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
   3. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch thick (14 gage).
   4. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick (14 gage).
   5. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

E. Supports and Anchors: Fabricated from not less than 0.042-inch thick (18 gage) electrolytic zinc-coated or metallic-coated steel sheet.

F. Jamb Anchors:
   1. Masonry Type: T-shaped anchors to suit frame size, not less than 0.042 inch thick (18 gage).
   2. Metal Stud-Wall Type: Slip in wood stud anchor equal to Curries M series; not less than 0.053 inch thick (16 gage).

G. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick (18 gage), and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

H. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

I. Plaster Guards: Formed from same material as frames, not less than 0.016-inch thick (28 gage) steel sheet to close off interior of openings; place at back of hardware cutouts where mortar or other materials might obstruct hardware operation.

2.05 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick (20 gage), fabricated from same material as door face sheet in which they are installed.
1. Provide non-removable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
2. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.

B. Fixed Frame Moldings: Formed integral with steel frames, minimum 5/8 inch high, unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick (20 gage), fabricated from same material as frames in which they are installed.

D. Astragals: As required by NFPA 80 to provide fire ratings indicated.

2.06 FABRICATION

A. General: Fabricate steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Steel Doors:
1. Exterior Doors: For exterior locations and elsewhere as indicated, fabricate doors, panels, and frames from metallic-coated steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 0.053-inch-thick (16 gage), metallic-coated steel channels with channel webs placed even with top and bottom edges. Seal joints in top edges of doors against water penetration.
2. Interior Door and Panel Faces: Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from cold-rolled steel sheet, unless otherwise indicated.
3. Pairs of Doors: Size of pairs of doors to provide maximum 3/16-inch gap between leafs to permit proper functioning of dead latching feature.
4. Glazed Lites: Factory cut openings in doors.

C. Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints; fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding; grind smooth and invisible.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.

4. Plaster Guards: Weld guards to frame at back of hardware mortises in frames installed in concrete or masonry.
5. Where installed in masonry, leave vertical mullions in frames open at top for grouting.
6. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor. Provide floor anchors for all frames.
7. Jamb Anchors: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
   a. Masonry Type:
      1) Two anchors per jamb up to 60 inches in height.
      2) Three anchors per jamb from 60 to 90 inches in height.
      3) Four anchors per jamb from 90 to 120 inches in height.
      4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof more than 120 inches in height.

   b. Stud-Wall Type:
      1) Three anchors per jamb up to 60 inches in height.
      2) Four anchors per jamb from 60 to 90 inches in height.
      3) Five anchors per jamb from 90 to 96 inches in height.
      4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in height.
      5) Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
8. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
9. Provide welded frames with temporary spreader bars for shipping.

D. Hardware Preparation: Factory prepare standard steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
1. Reinforce doors and frames to receive nontemplated mortised and surface-mounted door hardware. Through bolting will not be acceptable.
2. Comply with applicable requirements in ANSI A250.6 and ANSI/DHI A115 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of door or frame.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings such that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of doors and frames.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

F. Astragals: As required by NFPA 80 to provide fire ratings indicated.

2.07 STEEL FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Apply primers to steel doors and frames after assembly.

B. Comply with SSPC-PA1, "Paint Application Specification No. 1," for steel sheet finishes.

C. Metallic-Coated Steel Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
   1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

D. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

E. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils.
   1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of steel doors and frames.
   1. Examine roughing-in for embedded and built-in anchors to verify actual locations of steel frame connections before frame installation.
   2. If unacceptable conditions are encountered, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove welded-in shipping spreaders installed at factory.

B. Paint backside of frames to be set in masonry with bituminous coating.

C. Prior to installation, adjust and securely brace steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
   1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

D. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.03 INSTALLATION

A. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Steel Frames: Install standard steel frames for doors, sidelights, transoms, borrowed lights, and other openings, of size and profile indicated. Comply with SDI 105.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
   a. At fire-protection-rated openings, install frames according to NFPA 80.
   b. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   c. Install frames with removable glazing stops located on secure side of opening.
   d. Install door silencers in frames before grouting.
   e. Remove shipping straps at bottom of frames. Properly space frame using wood template that is full depth of frame and of proper spacing width during setting and anchoring of frames to maintain proper width, with frame plumb and square without twists. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   f. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   g. Apply bituminous coating to backs of frames that are filled with mortar, grout, and plaster.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors. Floor anchors are in addition to wall anchors.
   a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Metal-Stud Partitions: Attach wall anchors to studs with screws. Provide floor anchor at each jamb, in addition to the wall anchors.
4. Masonry Walls: Anchors shall be masonry T-shaped anchors. Provide floor anchor at each jamb, in addition to the wall anchors. Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division 4 Section "Unit Masonry Assemblies."
5. Installation Tolerances: Adjust steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
6. Mineral Fiber Insulation: Fill head and jambs of frames scheduled to receive sound seals with mineral fiber insulation.

C. Steel Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
   a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
   b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
   c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
   d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

4. Pairs of Doors: Install pairs of doors to provide maximum 3/16-inch gap between leafs and accurate alignment of strike to permit proper functioning of dead latching feature.

D. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with steel door and frame manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c., and not more than 2 inches o.c. from each corner.

3.04 ADJUSTING AND CLEANING

A. Final Adjustments: Remove and replace defective work, including steel doors or frames that are warped, bowed, or otherwise unacceptable.

B. Clean grout and other bonding material off steel doors and frames immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

END OF SECTION 08110

SECTION 082110

WOOD DOORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
1. Solid-core doors .
2. Factory finishing wood doors.
3. Factory glazing of fire-rated wood doors with glazed openings.

B. Related Sections include the following:
1. Division 8 Section "Glazing" for glass view panels in wood doors.

1.03 SUBMITTALS

A. General: Submit in accordance with Section 01330.
1. Submittals for Sections 08110, 08211, and 08710 shall be made concurrently.

B. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications. Include door manufacturer's storage, handling, finish, installation, and maintenance instructions.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; face veneer, construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire ratings for fire doors.

D. Door Schedule: Submit schedule of doors using same reference numbers for details and openings as those on Contract Drawings.
1. Indicate coordination of glazing frames and stops with glass and glazing requirements.

E. Samples: Submit the following:
1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edgings representing typical range of color and grain for each species of veneer and solid lumber required. Finish sample with same materials proposed for factory-finished doors.

3. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

C. Quality Standard: Comply with NWWDA I.S.1-A, "Architectural Wood Flush Doors" or AWI's "Architectural Woodwork Quality Standards Illustrated."

D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated.
   1. Test Pressure: Test at atmospheric (neutral) pressure according to NFPA 252 or UL 10B.
      a. Location: CMCC.
   2. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches or less above the sill.
      a. Location: EMCC and SMCC.
      b. EMCC currently does not have any wood doors, but if a rated wood door is added, it will need to comply with this requirement.
   3. Acceptable Fire-Rating Label: Underwriters' Laboratories, Inc. (U.L.) or Warnock Hersey.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect wood doors during transit, storage, and handling to prevent damage, soiling and deterioration. Comply with requirements of referenced standard, manufacturer's instructions, and recommendations of NWWDA I.S. 1, Appendix, "How to Store, Handle, Finish, Install and Maintain Wood Doors."
   1. Package doors at factory prior to shipping.
   2. Protect doors from extremes of heat and cold. Relative humidity shall not be less than 30 percent nor more than 60 percent.
   3. Compare pre-finished doors to approved finish sample upon delivery. Notify Architect if sample does not match.

B. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.07 WARRANTY

A. General: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and will be in addition to

and run concurrent with other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist), show telegraphing of core construction in face veneers, and which do not conform to tolerance limitations of specified quality standards.
   1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
   2. Warranty shall be in effect during the following period of time from date of Substantial Completion:
      a. Solid-Core Interior Doors: Life of installation.
      b. Interior Stile and Rail Doors: Life of installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Wood Doors:
      a. Algoma Hardwoods Inc.
      b. Eggers Industries; Architectural Door Division.
      c. Marshfield Door Systems, (Weyerhaeuser).
      d. VT Industries Inc.

2.02 DOOR CONSTRUCTION, GENERAL

A. Doors for Transparent Finish:
   1. Grade: Premium, with Grade A faces.
   2. Species and Cut: Natural white birch, rotary cut.
   3. Match between Veneer Leaves: Book match.
   4. Assembly of Veneer Leaves on Door Faces: Running match.
   5. Match: Provide door faces of compatible color and grain for doors hung in same opening or separated only by mullions.

2.03 SOLID-CORE DOORS

A. Interior Veneer-Faced Doors:
   1. Core: Particleboard for flush wood doors; structural composite lumber core for stile and rail doors.
   2. Construction: Five plies, hot pressed, with stiles and rails bonded to core, then entire unit abrasive planed before veneering. No substitution.

B. Fire-Rated Doors:
   1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.

2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as needed to eliminate through-bolting hardware.
3. Edge Construction: At hinge stiles, provide manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.
4. Pairs: Provide fire-rated pairs with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals..

2.04 LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors:
1. Wood Species: Same species as door faces.
2. Profile: Same shape as beads for light openings in fire-rated doors.
3. At 20-minute, fire-rated, wood-core doors, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire rating indicated. Include concealed metal glazing clips where required for opening size and fire rating indicated.
1. Glazing beads for rated and non-rated doors shall have the same profile.

C. Glazing in Fire-Rated Doors: Wire glass, ASTM C 1036, Type II (patterned and wired flat glass), Class 1 (clear), Quality q8 (glazing); 6 mm (0.23 inch) thick minimum.
1. Form 1 (wired glass, polished both sides).
2. Pattern: Mesh 2 (M2) (Square).
3. Location: CMCC and SMCC.

2.05 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:
1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.
2. Coordinate sizing of pairs of doors to provide maximum 3/16-inch gap between leafs to permit proper functioning of dead latching feature.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
1. Light Openings: Trim openings with moldings of material and profile indicated.

D. Factory glaze fire-rated doors with light openings.

2.06 FACTORY FINISHING

A. General: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated," Section 1500 for factory finishing.

B. Finish doors at factory.

C. Transparent Finish:
1. Grade: Custom.
2. Finish: AWI System, TR-6 catalyzed polyurethane.
3. Staining: None required.
4. Sheen: Satin.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.
1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Hardware: For installation, see Division 8 Section "Door Hardware."
1. Hinges shall be shimmed with metal shims at each door to provide equal clearance at each jamb.
2. Locks, exit devices, door closers and other hardware shall be installed in accordance with the manufacturer's instructions. Pilot holes of recommended size, for wood screws required to fasten the hardware, shall be drilled by the installing Contractor before screws are fastened to the wood doors.

B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.03 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08211

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Access doors and frames for walls and ceilings.

B. Related Sections include the following:
1. Division 04 Section "Unit Masonry" for anchoring and grouting access door frames set in masonry construction.
2. Division 07 Section "Roof Accessories" for roof hatches.
3. Division 09 Section "Acoustical Tile Ceilings" for suspended acoustical tile ceilings.
4. Division 23 Section "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.3 SUBMITTALS

A. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings**,** materials, individual components and profiles, and finishes**.**

B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each door face material, at least 3 by 5 inches (75 by 125 mm) in size, in specified finish.

D. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

E. Ceiling Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of access door(s) and frame(s) through one source from a single manufacturer.

B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 for vertical access doors and frames.
2. ASTM E 119 for horizontal access doors and frames.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

1. ASTM A 123/A 123M, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

1. ASTM A 123/A 123M, for galvanizing steel and iron products
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

C. Steel Sheet: Uncoated cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS) with A60 (ZF180) zinc-iron-alloy (galvannealed) coating or G60 (Z180) mill-phosphatized zinc coating in damp locations; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924/A 924M.

E. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

2. Surface Preparation for Metallic-Coated Steel Sheet: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

    a. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

F. Drywall Beads: Edge trim formed from 0.0299-inch (0.76-mm) zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.2 ALUMINUM MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

1. Mill finish, AA-M10 (Mechanical Finish: as fabricated, unspecified).

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15; with minimum sheet thickness indicated representing specified thickness according to ANSI H35.2 (ANSI H35.2(M)).

1. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written specifications for cleaning, conversion coating, and painting.

2.3 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Acudor Products, Inc.
2. Babcock-Davis; A Cierra Products Co.
3. Bar-Co, Inc. Div.; Alfab, Inc.
4. Cendrex Inc.
5. Dur-Red Products.
6. Elmdor/Stoneman; Div. of Acorn Engineering Co.
7. Jensen Industries.
8. J. L. Industries, Inc.
9. Karp Associates, Inc.
10. Larsen's Manufacturing Company.
11. MIFAB, Inc.
12. Milcor Inc.
13. Nystrom, Inc.

14. Williams Bros. Corporation of America (The).

B. Flush Access Doors and Frames: Fabricated from metallic-coated steel sheet.

1. Locations: Wall and ceiling surfaces.
2. Door: Minimum 0.060-inch- (1.5-mm-) thick sheet metal, set flush with surrounding finish surfaces.
3. Frame: Minimum 0.060-inch- (1.5-mm-) thick sheet metal with drywall bead flange.
4. Hinges: Spring-loaded, concealed-pin type.
5. Latch: Self-latching bolt operated by screwdriver with interior release.

C. Fire-Rated, Insulated, Flush Access Doors and Trimless Frames: Fabricated from metallic-coated steel sheet.

1. Locations: Wall and ceiling surfaces.
2. Fire-Resistance Rating: Not less than that indicated.
3. Temperature Rise Rating: 250 deg F (139 deg C) at the end of 30 minutes.
4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 inch (0.9 mm).
5. Frame: Minimum 0.060-inch- (1.5-mm-) thick sheet metal with drywall bead.
6. Hinges: Concealed-pin type.
7. Automatic Closer: Spring type.
8. Latch: Self-latching device operated by knurled knob with interior release.

2.4 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
1. Provide mounting holes in frames for attachment of units to metal or wood framing.
2. Provide mounting holes in frame for attachment of masonry anchors. Furnish adjustable metal masonry anchors**.**

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 08 33 00 – ROLLING COUNTER DOOR

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Manual rolling counter doors with integral frame [and countertop], built-in type.

B. Related Sections:
1. 05 50 00 Metal Fabrications. Door opening jamb and head members.
2. 06 10 00 Rough Carpentry. Door opening jamb and head members.
3. 08 31 00 Access Doors and Panels. Access doors.
4. 08 70 00 Hardware. Padlocks. Masterkeyed cylinder.
5. 09 91 00 Painting. Field painting.

1.2 SUBMITTALS

A. Reference Section 01 33 00 Submittal Procedures; submit the following items:
1. Product Data.
2. Shop Drawings: Include special conditions not detailed in Product Data. Show interface with adjacent work.
3. Quality Assurance/Control Submittals:
a. Provide proof of manufacturer ISO 9001:2008 registration.
b. Provide proof of manufacturer and installer qualifications - see 1.3 below.
c. Provide manufacturer's installation instructions.
4. Closeout Submittals:
a. Operation and Maintenance Manual.
b. Certificate stating that installed materials comply with this specification.

1.3 QUALITY ASSURANCE

A. Qualifications:
1. Manufacturer Qualifications: ISO 9001:2008 registered and a minimum of five years experience in producing counter doors with integral frame assembly of the type specified.
2. Installer Qualifications: Manufacturer's approval.

1.4 DELIVERY STORAGE AND HANDLING

A. Reference Section 01 66 00 Product Storage and Handling Requirements.

B. Follow manufacturer's instructions.

WARRANTY

A. Standard Warranty: Two years from date of shipment against defects in material and workmanship.

B. Maintenance: Submit for owner's consideration and acceptance of a maintenance service agreement for installed products.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Manufacturer: Cornell Iron Works, Inc., Crestwood Industrial Park, Mountaintop, PA 18707. Telephone: (800) 233-8366, Fax: (800) 526-0841 or architect approved equal

B. Model: ESC20

2.2 MATERIALS

A. Curtain:
1. Slats: No. 1F, interlocked flat-faced slats, 1-1/2 inches (38 mm) high by 1/2 inch (13 mm) deep, [22 gauge ASTM A 653, Commercial Quality, galvanized steel] [0.040 inch (1.016 mm) aluminum] with extruded tubular aluminum bottom bar with continuous lift handle and vinyl astragal.
2. Fabricate interlocking slat sections with high strength molded nylon endlocks riveted to ends of alternate slats.
3. Slat Finish:
a. Aluminum: Clear anodized.
4. Bottom Bar Finish:
a. Aluminum Bar/Steel Slat with Baked Enamel Coating: Clear anodized.

B. Head and Jamb Frame: Integral welded with guide groove incorporated into jamb design. Build to fit wall thickness as indicated on the drawings.
1. Stainless Steel: 16 gauge AISI 300 series formed shapes.
2. Finish:
a. Stainless steel: No. 4 finish.

C. Countertop: Integral 14 gauge AISI 300 series stainless steel formed shape; No. 4 finish.

D. Counterbalance Shaft Assembly:
1. Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot (2.5 mm per meter) of width.
2. Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs (110 N). Provide wheel for applying and adjusting spring torque.

E. Brackets: Fabricate from reinforced [steel] [AISI 300 series stainless steel] plate with bearings at rotating support points to support counterbalance shaft assembly and form end closures for hood.
1. Finish:

a. Stainless Steel: No. 6 finish.

F. Hood: 16 gauge stainless steel with reinforced top and bottom edges.
1. Finish:
a. Stainless Steel: No. 6 finish.

2.3 ACCESSORIES

2.4 FABRICATION

A. Factory weld head, and jambs into single unit, fully assembled, ready for installation.

2.5 OPERATION

A. Manual Push-Up: Provide lift handles on bottom bar and pole with hook.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates upon which work will be installed and verify conditions are in accordance with approved shop drawings.

B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.

C. Commencement of work by installer is acceptance of substrate.

3.2 INSTALLATION

A. General: Install door unit and operating equipment with necessary hardware, anchors, inserts, hangers and supports.

B. Follow manufacturer's installation instructions.

3.3 ADJUSTING

A. Following completion of installation, including related work by others, lubricate, test, and adjust doors for ease of operation, free from warp, twist, or distortion.

3.4 CLEANING

A. Clean surfaces soiled by work as recommended by manufacturer.

B. Remove surplus materials and debris from the site.

3.5 DEMONSTRATION

A. Demonstrate proper operation to Owner's Representative.

B. Instruct Owner's Representative in maintenance procedures.

END OF SECTION

SECTION 08 33 10 – AUTOMATIC OVERHEAD DOORS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Provide all materials, labor, equipment and services necessary to furnish, deliver and install all work under this section as shown on the contract documents, specified herein, and as specified by the job conditions.

1.02 DESCRIPTION

A. Related work specified elsewhere:

1. Metal Fabrication.	Section 05 50 00
2. Rough Carpentry.	Section 06 10 00
3. Access Panels & Doors:	Section 08 31 00
4. Painting:	Section 09 91 00
5. Electrical:	Division 26

1.03 SUBMITTALS

A. Procedures: Furnish submittals in accordance with the general requirements specified.

B. Shop Drawing: Furnish shop drawings for architect's approval. Include elevations, sections, and details indicating dimensions, materials, finishes, conditions for anchorage and support of each door.

C. Certifications:
1. Submit manufacturer’s Underwriters Laboratories (UL), Warnock Hersey (WH) or Factory Mutual Research (FM) laboratory test report verifying product compliance in accordance with the required fire and smoke ratings.
2. Provide manufacturer’s ICC Evaluation Service report confirming compliance of the fire door assembly in accordance with the requirements of the Building Code.

D. Product Literature: Submit manufacturer's technical literature describing the product to be used under this section.

E. Maintenance and Operating Manuals: Furnish complete manuals describing the materials, devices and procedures to be followed in operating and maintaining all doors under this section. Include manufacturer's brochures and parts lists describing the actual materials used in the product.

1.04 QUALITY ASSURANCE

A. Fire & Smoke Rated Assemblies: Provide all doors with fire and smoke resistance rating required to comply with governing regulations which are inspected, tested, listed and labeled by UL, WH or FM and complying with NFPA 80 for class of opening. Provide units tested in accordance with the requirements of UL 10B, UL 1784, NFPA 252, ASTM E-152. Provide testing laboratory label permanently fastened to each fire and smoke door assembly.

B. Regulatory Requirements:
1. Comply with applicable requirements of the laws, codes, ordinances and regulations of federal, state and municipal authorities having jurisdiction.

2. Listed by the ICC Evaluation Service in accordance with the applicable sections of the Building Code.

C. Testing: Provide documentation from a certified testing agency that the fire door's self-closing governor mechanism and fire door operator have been tested for a minimum of 50,000 cycles and 500 self closing trip tests.

D. Manufacturer Requirements: Door manufacturer shall have been in the business of and have experience in manufacturing the type of product covered under this specification section as well as giving credible service for a minimum of five (5) years. Provide list of at least ten (10) completed projects which include the products covered under this section.

1.05 DELIVERY, STORAGE AND HANDLING

A. General: Deliver and store materials in manufacturer's original packaging, labeled to show name, brand and type. Store materials in a protected dry location off the ground in accordance with manufacturer's instructions.

1.06 WARRANTY

A. Door Warranty: Furnish one (1) year written warranty signed by the manufacturer and installer agreeing to repair or replace work which has failed as a result of defects in materials or workmanship. Upon notification within the warranty period, such defects shall be repaired at no cost to the owner.

PART 2 PRODUCTS

2.01 INSULATED FIRE & SMOKE RATED DOORS

A. Manufacturer: Insulated fire and smoke rated doors for climatic control shall be the Auto-Set System model FSFD-IS-M-G as manufactured by McKeon Door Company or architectural equal.

2.02 MATERIALS

A. Curtain: Shall be assembled of interlocking galvanized steel slats. Slats shall have endlocks locking each end of all alternate slats to act as a wearing surface, and maintain slat alignment. Curtain shall be formed of 22 gauge front and back panel slats. The void of the curtain slats shall be filled with rockwool insulation and the front and back panel slats must have a positive interlock. Slats with snap-in back panels are not acceptable.
   1. Slats: Shall be of a cross section not less than 2-5/8" wide by 7/8" deep.

B. Bottom Bar: Shall consist of two (2) angles, each not less than 2" x 2" x 1/8" steel formed to fit slats.

C. Guides: Each guide assembly shall be fabricated of a minimum 3" x 3" steel support angle or tube, a 2" x 3" inner guide angle and a 3" x 3" outer guide angle. Support tubes shall be constructed with a slip joint at the top to provide for thermal expansion and guide angles shall be provided with slotted holes to allow for thermal expansion.
   1. Provide internal, fully concealed UL Classified smoke seals located within each guide assembly. Externally mounted smoke seals shall not be acceptable.

D. Mounting Brackets: Fabricated of hot rolled 3/16" steel plate minimum, brackets shall be provided to house ends of the counterbalance barrel assembly.

E. Hood: Shall be provided to entirely enclose curtain and counterbalance barrel assembly. Hood shall be fabricated 22 gauge galvanized steel and designed to match brackets. Top and bottom shall be bent and reinforced for stiffness.
   1. Provide UL Classified lintel smoke seals.

F. Counterbalance Assembly: Fire door shall be counterbalanced by means of adjustable steel helical torsion springs attached to shaft enclosed in pipe with required mounting blocks or rings for attachment of curtain. Grease sealed bearings or self-lubricating graphite bearings shall be attached to the spring barrel which shall be fabricated of hot formed structural quality carbon steel seamless pipe.

G. Electric Motor Operator: Fire door shall be provided with a compact power unit designed and built by the door manufacturer. Operator shall be equipped with an adjustable screw-type limit switch to break the circuit at termination of travel. High efficiency planetary gearing running in an oil bath, shall be furnished together with a centrifugal governor, magnetic operated brake and a fail-safe magnetic release device, completely housed to protect against damage, dust and moisture. An efficient overload protection device, which will break the power circuit and protect against damage to the motor windings shall be integral with the unit. Operator is to be housed in a NEMA type 1 enclosure.
   1. Motor: Shall be intermediate duty, thermally protected, ball bearing type with a class A or better insulation. Horsepower of motor is to be 1/3hp minimum or of manufacturer's recommended size, which ever is greater.
   2. Starter: Shall be size "0" magnetic reversing starter, across the line type with mechanical and electrical interlocks, with 10 amp continuous rating and 24 volt control circuit.
   3. Reducer: Planetary gear type, 80% efficiency minimum.
   4. Brake: Magnetically activated, integral within the operator's housing.
   5. Control Station: Provide flush mount key switch control station marked open, close and stop.

H. Self-Closing Mechanism: The fire door is to be designed with a centrifugal governor as an integral part of the operator's construction. The automatic release mechanism shall be activated by a fusible link, smoke detector or fire alarm. When activated the door is released and begins to close due to gravitational force. The speed of the door is governed by a centrifugal governor, designed to match the normal operating speed of the door, at a rate of not greater than 9" per second or less than 6" per second.

I. Magnetic Release with 10 Second Time Delay: A fail-safe magnetic release device shall be built into the operator as an integral part of the release mechanism. When power is interrupted to the release mechanism by the smoke detector or fire alarm, the door shall begin to self-close. In the event of power failure the time delay shall prevent the fire door from closing for a period of 10 seconds. Once the 10 seconds have lapsed, the fire door shall self-close. Once power has been restored to the release mechanism the automatic reset time delay as well as the fire door shall automatically reset themselves.

J. Obstruction Sensing Safety Edge: The fire door shall be designed with an obstruction sensing safety edge. In the event that the safety edge meets an obstruction during the normal closing operation, the door shall stop, reverse and return to the open position. In the event the safety edge meets an obstruction during the self-closing operation, the door shall come to rest on the obstruction and once the obstruction has been removed the fire door shall continue to the fully closed position.

K. Easy Trip Test Feature: The fire door shall be designed so that it may be trip tested simply by cutting power to the operator. By turning the power switch off, the door shall self-close. Once the fire door has satisfactorily closed, it shall be reset simply by turning the power back on. No ladders or tools shall be needed to reset the door or the time delay unit.

L. True Test Panel: Fire doors shall be provided with a True Test panel. The test panel shall activate all the fire doors to close via gravity not power and shall be in accordance with NFPA Bulletin 80. Only one test panel shall be required to test all the fire doors on this project.

M. Finish: After completion of fabrication, clean all metal surfaces to remove dirt and chemically treat to provide for paint adhesion. Curtain assembly is to receive a prime coat finish of .2 mils of epoxy primer and .8 mils of manufacturer's standard finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces and field conditions to which this work is to be performed and notify architect if conditions of surfaces exist which are detrimental to proper installation and timely completion of work.

B. Verify all dimensions taken at job site affecting the work. Notify the architect in any instance where dimensions vary.

C. Coordinate and schedule work under this section with work of other sections so as not to delay job progress.

3.02 INSTALLATION

A. Perform installation using only factory approved and certified representatives of the door manufacturer.

B. Install door assemblies at locations shown in perfect alignment and elevation, plumb, level, straight and true.

C. Adjust door installation to provide uniform clearances and smooth non-binding operation.

D. Install wiring in accordance with applicable local codes and the National Electrical Code Standard. Materials shall be UL listed.

E. Test door closing sequence when activated by the building's fire alarm system. Reset door after successful test.

3.03 PROTECTION AND CLEANING

A. Protect installed work using adequate and suitable means during and after installation until accepted by owner.

B. Remove, repair or replace materials which have been damaged in any way.

C. Clean surfaces of grime and dirt using acceptable and recommended means and methods.

SECTION 084110

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
1. Exterior and interior aluminum-framed storefronts.
a. Glazing is retained mechanically with gaskets on four sides.
b. Subframe for exterior aluminum-framed storefronts.
2. Exterior and interior manual-swing aluminum doors.
3. Exterior and interior aluminum door frames.
4. Operable units in storefront.
5. Single hung aluminum windows.
6. Break metal in conjunction with frames.
7. Door hardware.
8. Sealant at interior and exterior perimeter of storefront.

B. Related Sections include the following:
1. Division 7 Section "Joint Sealants" for installation of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.
2. Division 8 Section "Door Hardware" for hardware to the extent not specified in this Section.
3. Division 8 Section "Glazing" for glazing requirements to the extent not specified in this Section.

1.03 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
4. Dimensional tolerances of building frame and other adjacent construction.
5. Failure includes the following:
a. Deflection exceeding specified limits.
b. Thermal stresses transferred to building structure.
c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
d. Noise or vibration created by wind and thermal and structural movements.
e. Loosening or weakening of fasteners, attachments, and other components.
f. Sealant failure.
g. Failure of operating units to function properly.

B. Structural Loads:
1. Wind Loads: As indicated on Drawings.
2. Seismic Loads: As indicated on Drawings.
3. Code: As indicated.

C. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.

D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity but not less than 10 seconds.

E. Seismic Loads: Provide entrance and storefront systems, including anchorage, capable of withstanding the effects of earthquake motions calculated according to requirements of authorities having jurisdiction or ASCE 7-98, "Minimum Design Loads for Buildings and Other Structures," Section 9, "Earthquake Loads," whichever are more stringent.

F. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

G. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft..

H. Water Penetration Under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

I. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 62 when tested according to AAMA 1503.

J. Average Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having average U-factor of not more than 0.44 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.

1.04 SUBMITTALS

A. General: Submit in accordance with Section 01330.

B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.
1. Submit replacement parts lists, adjustment instructions, and maintenance requirements for all components and hardware.

C. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

2. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
3. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
4. Indicate fastener layout and size for transferring loads back to supporting structure.

D. Samples:
1. Sealants: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

E. Welding certificates.

F. Qualification Data: For Installer signed by manufacturer certifying that Installers comply with requirements in "Quality Assurance" Article.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.

H. Manufacturer's Field Reports: Manufacturer's field service representative shall submit field inspection report of product installation to Architect.

I. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
1. Include maintenance manuals for hardware provided in this Section.

J. Warranties: Special warranties specified in this Section.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section, who is acceptable to manufacturer, and is able to obtain specified manufacturer's warranty.
1. Engineering Responsibility: Preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of glazed storefront systems that are similar to those indicated for this Project in material, design, and extent.

C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. Source Limitations: Obtain each type of aluminum-framed entrance, window, and storefront from one source and by a single manufacturer.
1. Aluminum-framed entrances and storefront systems specified in this Section and curtain wall system specified in Division 8 Section "Glazed Aluminum Curtain Wall" shall be from same manufacturer.

E. Accessible Entrances: Comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

F. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."

G. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to glazed aluminum storefront and entrance systems including, but not limited to, the following:
1. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
2. Review structural loading limitations.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review required inspecting, testing, and certifying procedures.
5. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions.
6. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
7. Provide 72-hour minimum advance notice to participants prior to convening preinstallation conference.

H. Field Quality Control: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instruction. Upon completion of installation, manufacturer's field representative shall prepare written report on installation of systems.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Coordinate rough opening, masonry opening, and wood blocking requirements.

1.07 WARRANTY

A. General: Special warranties specified in this Section shall not deprive Owner of other rights Owner may have under other provisions of Contract Documents and will be in addition to and run concurrent with other warranties made by Contractor under requirements of Contract Documents.

B. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Structural failures including, but not limited to, excessive deflection.
b. Failure of system to meet performance requirements.
c. Noise or vibration caused by thermal movements.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
e. Adhesive or cohesive sealant failures.
f. Water leakage through fixed glazing and framing areas.
g. Failure of operating components to function properly.
h. Glazing breakage.
2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:
1. Kawneer Company, Inc.:
a. Exterior Storefront and Entrances: 451T frames with 350 Heavy Wall Entrances and Frames.
b. Interior Storefront and Entrances: 451 frames with 350 Heavy Wall Entrances and Frames.
2. Vistawall Architectural Products:
a. Exterior Storefront and Entrances: Series 3000 poured and debridged Thermal Storefront System with Rugged MS Entrances and Frames.
b. Interior Storefront and Entrances: Series 3000 with Rugged MS Entrances and Frames.

2.02 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10.

B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
1. Structural Shapes, Plates, and Bars: ASTM A 36.
2. Cold-Rolled Sheet and Strip: ASTM A 1008.
3. Hot-Rolled Sheet and Strip: ASTM A 1011.

2.03 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Fixed, center-plane systems as follows:
a. Exterior Framing Members: Composite assemblies of two separate extruded-aluminum components permanently bonded by an elastomeric material of low thermal conductance.
b. Interior Framing Members: Nonthermal.
2. Provide thermally broken extruded aluminum sill flashing with end dams for storefronts.
3. Provide thermally broken extruded aluminum subframes for storefronts.
4. Provide operable units (windows and doors) manufactured by storefront system manufacturer.
5. Provide components having face width indicated on Drawings.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
1. Provide extra-heavy reinforcement for hinges and closers at doors over 7'-0" in height.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
2. Reinforce members as required to receive fastener threads.

3. Do not use exposed fasteners, except for hardware application. For hardware application, use exposed fasteners with countersunk Phillips screw heads, finished to match framing system or hardware being fastened, unless otherwise noted. Exposed fasteners shall be stainless steel.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

F. Aluminum Break Metal: Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness, not less than 0.125-inch thick, to maintain a flat appearance without visible deflection.

G. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.04 GLAZING SYSTEMS

A. Glazing: As specified in Division 8 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard pressure-glazing system of black, extruded EPDM rubber gaskets, fabricated to comply with system performance requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.

C. Spacers and Setting Blocks: Manufacturer's standard permanent, nonmigrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.

D. Provide framing system gaskets, sealants, and joint fillers recommended by manufacturer for joint type.

E. Sealants and Joint Fillers: Provide for joints at perimeter of entrance and storefront systems as specified in Division 7 Section "Joint Sealants."

F. U-Value needs to meet or exceed 0.42

2.05 DOORS

A. Doors: Manufacturer's standard glazed doors, for manual and power-assisted swing operation.
1. Door Construction: 2-inch overall thickness, with minimum 0.188-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.
2. Door Design: Medium stile; 3-1/2-inch nominal width, 10-inch high bottom rail, and 6-inch cross rail.
3. Door Frame: Minimum 0.188-inch thick, extruded aluminum; 2-inch by 4-1/2 inch profile, stop with weatherstripping; run heavy weight jambs full height of opening.
4. Glazing Stops and Gaskets: Manufacturer's heavy weight removable mullion with weatherstripping, finish to match frame.
   a. Provide nonremovable glazing stops on outside of exterior doors.

2.06 DOOR HARDWARE

A. General: Provide heavy-duty units in sizes, numbers, and types recommended by entrance system and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish, unless otherwise indicated. Provide specified manufacturers without substitution.
   1. Opening-Force Requirements:
      a. Egress Doors: Not more than 30 lbf required to set door in motion and not more than 15 lbf required to open door to minimum required width.
      b. Accessible Interior Doors: Not more than 5 lbf.

B. Ball-Bearing Butts:

   1. Standard: BHMA A156.1, Grade 1, radius corner.
   2. Provide nonremovable pins at hinges exposed to outside of door.
   3. Provide nonferrous hinges where hinges are exposed to weather.
   4. Quantities:
      a. For doors with heights up to **87 inches (2210 mm)**, provide 3 hinges per leaf.
      b. For doors with heights of greater than **87 and up to 120 inches (2210 and up to 3048 mm)**, provide 4 hinges per leaf.

C. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
   1. As specified in Division 08 Section "Door Hardware".

D. Cylinders: As specified in Division 08 "Door Hardware".

E. Operating Trim: BHMA A156.6.

F. Closers: With accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use, and adjustable to meet field conditions and requirements for opening force.
   1. As specified in Division 08 Section "Door Hardware".

G. Surface-Mounted Holders: BHMA A156.16, Grade 1.

H. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

I. Weather Stripping: Manufacturer's standard replaceable components.
   1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC. Provide at head and jamb of all exterior doors.

J. Weather Sweeps: Manufacturer's standard exterior door bottom sweep with concealed fasteners on mounting strip.

K. Thresholds: Raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch. Coordinate cutouts for operating hardware with anchors and jamb clips.
   1. Material: Aluminum, mill finish.

L. Balance of Hardware: See Division 8 Section "Door Hardware."

M. Schedule:
   1. 100A and 135A Provide:
      a. hinges
      b. panic exit devices
      c. operating trim
      d. door pulls
      e. closers

f. weather stripping
g. weather sweeps
h. thresholds
i. Automate door opener

2. 100B Provide:
a. hinges
b. panic exit devices
c. operating trim
d. door pulls
e. closers
f. weather stripping
g. weather sweeps
h. thresholds
i. Otherwise required
j. Door stops

2.07 OPERABLE WINDOW UNITS

A. Projected Windows: Provide manufacturer's thermally broken, top-hinged, outward swinging window designed for use in storefront system. Finish to match storefront system.
1. Kawneer: GlassVent.
2. Vistawall: ZS 2750.

B. Window Hardware: Provide the following:
1. Operator: Cam operator and locking.
2. Hinges: Comply with AAMA 904; concealed four-bar friction hinge with adjustable-slide friction shoe; two per ventilator.
3. Weatherstipping: Manufacturer's standard compressible, replaceable weatherstripping designed for permanently sealing under bumper action around full perimeter of unit, and completely concealed when ventilator is closed.

2.08 ALUMINUM WINDOWS
1. Finish: To match storefront.

B. Hardware and Weather Stripping: Provide the following:
1. Sash Balance: Concealed, spring-loaded, block-and-tackle type, Class 5, to hold sash stationary at any open position; two per sash.
2. Handle: Continuous, integral, sash lift bar on bottom rail of forward-placed operating sash.
3. Sash Lock: Cam-action sweep lock and keeper on meeting rail; on sash wider than 36 inches provide two per sash.
4. Safety Devices: Provide sash stop in balance track to limit clear opening to 8 inches for ventilation at single hung units. Provide keyed custodial locks to prevent unauthorized tilting of sash.
5. Weather Stripping: Provide woven-pile, full-perimeter weather stripping for each operable sash, unless otherwise indicated. Comply with AAMA 701/702.

C. INSECT SCREENS
1. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on outside of double hung windows and provide for each operable exterior sash.

a. Comply with SMA 1004, "Specifications for Aluminum Tubular Frame Screens for Windows," for minimum standards of appearance, fabrication, attachment of screen fabric, hardware, and accessories unless more stringent requirements are indicated.
b. Location: On interior side of awning windows and on exterior of single hung units.

2. Aluminum Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
   a. Extruded-Aluminum or Aluminum Tubular Framing Sections and Cross Braces: Not less than 0.050-inch wall thickness.
   b. Finish: Match aluminum storefront and window members, unless otherwise noted.
3. Aluminum Wire Fabric: 18-by-16 mesh of 0.011-inch- diameter, coated aluminum wire.
   a. Wire-Fabric Finish: Charcoal gray.

2.09 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."

B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.10 FABRICATION

A. Form aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from exterior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).

E. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.
1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

F. Doors: Reinforce doors as required for installing hardware.
1. At exterior doors, provide weather sweeps applied to door bottoms and compression weather stripping at fixed stops.

G. Windows: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact. Fabricate units that are reglazable without dismantling sash or ventilator framing.
   1. Provide hardware with low conductivity or nonmetallic material for hardware bridging thermal breaks at frame or vent sash.
   2. Provide full-perimeter weather stripping for each operable sash and ventilator.

H. Hardware Installation: Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed and field-installed hardware before applying finishes.

I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.11 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
   1. Color and Gloss: .Color to be selected by Architect from manufacturer's full range of warm and cool whites to match vinyl windows and glazed aluminum curtain walls.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General:
   1. Comply with manufacturer's written instructions.
   2. Do not install damaged components.
   3. Fit joints to produce hairline joints free of burrs and distortion.
   4. Rigidly secure nonmovement joints.
   5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
   6. Seal joints watertight, unless otherwise indicated.

B. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.

2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation. Install sills in one piece, full width of opening except where opening exceeds available manufactured lengths. Provide sealed metal end dams at ends of sills. Sills shall turn up on backside to form pan, directing water to the exterior.

E. Secure subframes to opening framing. Caulk exterior perimeter with backer rod and sealant. Caulk around interior perimeter between frame and the air/vapor barrier with backer rod and sealant.

F. Install components plumb and true in alignment with established lines and grades, without warp or rack.

G. Install glazing as specified in Division 8 Section "Glazing."

H. Entrances and Windows: Install to produce smooth operation and tight fit at contact points.
1. Exterior Entrances and Windows: Install to produce tight fit at weather stripping and weathertight closure.
2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
3. Install hardware furnished in Division 8 Section "Door Hardware."

I. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation. Color of sealant to match aluminum finish.

J. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:
1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:
   a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
   b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.

3.03 ADJUSTING AND CLEANING

A. Entrances and Windows: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions.
1. Provide tight fit at contact points and weather stripping. Provide smooth operation and weathertight closure. Frame shall be free from distortion.

B. Remove excess sealant and glazing compounds and dirt from surfaces. Remove nonpermanent labels and clean surfaces.

3.04 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensures entrances and storefront systems are without damage or deterioration at time of Substantial Completion.

END OF SECTION 08411

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes conventionally glazed aluminum curtain walls.

B. Related Sections include the following:

1. Division 07 Section "Thermal Insulation" for insulation materials field installed with glazed aluminum curtain-wall systems.
2. Division 07 Section "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain-wall systems and for sealants to the extent not specified in this Section.
3. Division 08 Section "Aluminum-Framed Entrances and Storefronts" for entrance **and storefront** systems installed with glazed aluminum curtain-wall systems.
4. Division 08 Section "Glazing" for insulating-glass requirements.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide glazed aluminum curtain-wall systems, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
4. Dimensional tolerances of building frame and other adjacent construction.
5. Failure includes the following:

    a. Deflection exceeding specified limits.
    b. Thermal stresses transferred to building structure.
    c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
    d. Noise or vibration created by wind and thermal and structural movements.
    e. Loosening or weakening of fasteners, attachments, and other components.
    f. Sealant failure.

B. Structural Loads:

1. Wind Loads: **As indicated on Drawings**.
2. Seismic Loads: **As indicated on Drawings**.
3. Periodic Maintenance-Equipment Loads: **As indicated on Drawings**.

C. Structural-Test Performance: Provide glazed aluminum curtain-wall systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at **150** percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding **0.2** percent of span.
3. Test Duration: As required by design wind velocity but not less than **10** seconds.

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to **1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m)** or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to **1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller**.

    a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, limited to 2 times the length of cantilevered member, divided by 175.

E. Thermal Movements: Provide glazed aluminum curtain-wall systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Test Performance: No buckling, stress on glass, glazing-edge seal failure, sealant failure, excess stress on curtain-wall framing, anchors and fasteners, or reduction of performance when tested according to AAMA 501.5.

    a. Test High Exterior Ambient Air Temperature: That which produces an exterior metal surface temperature of **180 deg F (82 deg C)**.
    b. Test Low Exterior Ambient Air Temperature: **0 deg F (minus 18 deg C)**.
    c. Test Interior Ambient Air Temperature: **75 deg F (24 deg C)**.

F. Air Infiltration: Provide glazed aluminum curtain-wall systems with maximum air leakage of **0.06 cfm/sq. ft. (0.03 L/s per sq. m)** of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure differential of **1.57 lbf/sq. ft. (75 Pa)**.

G. Water Penetration Under Static Pressure: Provide aluminum glazed curtain-wall systems that do not evidence water penetration when tested according to ASTM E 331 at a minimum

differential static pressure of **20 percent of positive design wind load, but not less than 10 lbf/sq. ft. (479 Pa)**.

H. Water Penetration Under Dynamic Pressure: Provide glazed aluminum curtain-wall systems that do not evidence water leakage when tested according to AAMA 501.1 under dynamic pressure equal to **20 percent of positive design wind load, but not less than 10 lbf/sq. ft. (479 Pa)**.

1. Maximum Water Leakage: **According to AAMA 501.1**. Water controlled by flashing and gutters that is drained to exterior and cannot damage adjacent materials or finishes is not considered water leakage.

I. Condensation Resistance: Provide glazed aluminum curtain-wall systems with condensation-resistance factor (CRF) of not less than [**55**] <**Insert CRF**> when tested according to AAMA 1503.

J. Average Thermal Conductance: Provide glazed aluminum curtain-wall systems with average U-factor of not more than **0.66 Btu/sq. ft. x h x deg F (3.75 W/sq. m x K)** when tested according to AAMA 1503.

K. Sound Transmission: Provide glazed aluminum curtain-wall systems with minimum STC **32** according to ASTM E 413 and an OITC **26** according to ASTM E 1332, as determined by testing according to ASTM E 90.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

B. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of glazed aluminum curtain-wall systems.

1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

F. Welding certificates.

G. Qualification Data: For Installer[**and testing agency**].

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for glazed aluminum curtain-wall systems.

I. Preconstruction Testing Program: Developed specifically for Project.

J. Preconstruction Test Reports: For glazed aluminum curtain-wall systems.

K. Field quality-control test reports.

L. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Capable of assuming engineering responsibility and performing Work of this Section and who is acceptable to manufacturer.

1. Engineering Responsibility: Preparation of data for glazed aluminum curtain-wall systems including the following:

a. Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.
b. Shop Drawings, Project-specific preconstruction-testing program development, and comprehensive engineering analysis by a qualified professional engineer.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 699 for testing indicated.

C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."

E. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Field testing shall be performed on mockups according to requirements in Part 3 "Field Quality Control" Article.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to glazed aluminum curtain-wall systems including, but not limited to, the following:

1. Review structural load limitations.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review required testing, inspecting, and certifying procedures.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain-wall systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating glazed aluminum curtain-wall systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 WARRANTY

A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of glazed aluminum curtain-wall systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Deterioration of metals, **metal finishes,** and other materials beyond normal weathering.
d. Water leakage.
e. Failure of operating components to function normally.

2. Warranty Period: **10** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advanced Building Systems, Inc.
2. Arch Aluminum & Glass Co., Inc.
3. Bruce Wall Systems Corp.

4. CMI Architectural Products, Inc.
5. EFCO Corporation.
6. Flour City International, Inc.
7. Kawneer.
8. Regal Manufacturing Co.
9. Tubelite, Inc.
10. United States Aluminum.
11. Vistawall Architectural Products.
12. Waltek & Company Limited.
13. Wausau Window and Wall Systems.
14. YKK AP America Inc.

2.2 FRAMING SYSTEMS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221 (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 611.
3. Hot-Rolled Sheet and Strip: ASTM A 570/A 570M.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads.
4. Finish exposed portions to match framing system.
5. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.

E. Anchors: Three-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

F. Concealed Flashing: **Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.**

G. Framing Gaskets: **As recommended by manufacturer for joint type**.

H. Framing Sealants: As **recommended by manufacturer for joint type.**

2.3 GLAZING SYSTEMS

A. Glazing: As specified in Division 08 Section "Glazing."

B. U-Value needs to meet or exceed 0.43

2.4 OPERABLE UNITS

A. Doors: As specified in Division 08 Section "Aluminum-Framed Entrances and Storefronts."

2.5 ACCESSORY MATERIALS

A. Insulating Materials: Specified in Division 07 Section "Thermal Insulation."

B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.6 FABRICATION

A. Form aluminum shapes before finishing.

B. Fabricate components that, when assembled, have the following characteristics:

1. Sharp profiles, straight and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to prevent glazing-to-glazing contact and to maintain required glazing edge clearances.
6. Provisions for reglazing from **interior where practical and exterior for everywhere else**

C. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

D. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.
2. Seal joints watertight, unless otherwise indicated.
3. Pressure equalize system at its interior face.
4. Install glazing to comply with requirements in Division 08 Section "Glazing."

E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA [**2604**] [**2605**] and with coating and resin manufacturers' written instructions.

1. Color and Gloss: **As selected by Architect from manufacturer's full range**.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight, unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified Division 08 Section "Glazing."

G. Install sealants as specified in Division 07 Section "Joint Sealants."

H. Install insulation materials as specified in Division 07 Section "Thermal Insulation."

I. Erection Tolerances: Install glazed aluminum curtain-wall systems to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3 mm in 3 m); 1/4 inch in 40 feet (6 mm in 12 m).
2. Level: 1/8 inch in 20 feet (3 mm in 6 m); 1/4 inch in 40 feet (6 mm in 12 m).
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (13 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (13 to 25 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
    c. Where surfaces are separated by reveal or protruding element of 1 inch (25 mm) wide or greater, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/2 inch (12.7 mm) over total length.

END OF SECTION 084413

SECTION 085413 - FIBERGLASS WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes All Ultrex® Impervia or other architectural approved equal single hung window complete with hardware, glazing, weather strip, insect half screen, grilles-between-the glass, jamb extension, sheet rock return, j-channel, and standard or specified anchors, trim and attachments. Types include:
2. Double hung or single hung
a. Where double hungs are shown, single hung are acceptable

1.3 Related Sections:

1. Division 1 Section "Sustainable Design Requirements"

1.3 DEFINITIONS

A. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:

1. AW: Architectural.
2. HC: Heavy Commercial.
3. C: Commercial.
4. LC: Light Commercial.
5. R: Residential.

B. Performance grade number according to AAMA/WDMA 101/I.S.2/NAFS:

1. Design pressure number in pounds force per square foot (pascals) used to determine the structural test pressure and water test pressure.

C. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.

D. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of test size indicated below:
   1. Size indicated on Drawings.

B. Structural Performance: Provide windows capable of withstanding the effects of the following loads, based on testing units representative of those indicated for Project that pass AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Structural Test:

   1. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour (meters per second) at 33 feet (10 m) above grade, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.

      a. Basic Wind Speed: see drawings.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of window indicated.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:

   1. Mullion details, including reinforcement and stiffeners.
   2. Joinery details.
   3. Expansion provisions.
   4. Flashing and drainage details.
   5. Weather-stripping details.
   6. Glazing details.
   7. Window cleaning provisions.
   8. For installed products indicated to comply with design loads, include structural analysis data prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of windows, and used to determine structural test pressures and design pressures from basic wind speeds indicated.

C. Samples for Initial Selection: For units with factory-applied color finishes.

   1. Include similar Samples of hardware and accessories involving color selection.

D. Samples for Verification: For windows and components required, prepared on Samples of size indicated below.

   1. Main Framing Member: 12-inch- (300-mm-) long, full-size sections of window frame with factory-applied color finish.

2. Window Corner Fabrication: 12-by-12-inch- (300-by-300-mm-) long, full-size window corner including full-size sections of window frame with factory-applied color finish, weather stripping, and glazing.
3. Operable Window: Full-size unit with factory-applied finish.
4. Hardware: Full-size units with factory-applied finish.

E. Product Schedule: For windows. Use same designations indicated on Drawings.

F. Qualification Data: For Installer manufacturer and testing agency.

G. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency for each type, class, grade, and size of window. Test results based on use of downsized test units will not be accepted.

H. Maintenance Data: For windows and finishes to include in maintenance manuals.

I. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to window manufacturer for installation of units required for this Project.

1. Installer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of data for windows, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A manufacturer capable of fabricating windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

C. Source Limitations: Obtain windows through one source from a single manufacturer.

D. Product Options: Information on Drawings and in Specifications establishes requirements for windows' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

E. Product Options: Drawings indicate size, profiles, and dimensional requirements of windows and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements." Do not modify size and dimensional requirements.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

F. Fenestration Standard: Comply with AAMA/WDMA 101/I.S.2/NAFS, "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors," for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

G. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to windows including, but not limited to, the following:

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review, discuss, and coordinate the interrelationship of windows with other exterior wall components. Include provisions for structural anchorage, glazing, flashing, weeping, sealants, and protection of finishes.
3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

K. Regulatory Requirements: Emergency Egress or Rescue: Comply with requirements for sleeping units of [IBC International Building Code] [BOCA Basic Building Code] [Southern Building Code] [Uniform Building Code].

1.7 DELIVERY

A. Comply with provisions of Section 01 65 00.

B. Deliver in original packaging and protect from weather.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.9 WARRANTY

A. Windows shall be warranted to be free from defects in manufacturing, materials, and workmanship for a period of ten (10) years from purchase date.

B. Window glass shall be warranted to be free from defects in manufacturing, materials and workmanship for period of twenty (20) years from the purchase date.

1.10 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. E 283: Standard Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.
   2. E 330: Standard Test Method for Structural Performance of Exterior Windows, Curtains Walls, and Doors by Uniform Static Air Pressure Difference.
   3. E 547: Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential.
   4. E 774: Specification for Sealed Insulated Glass Units.
   5. C 1036: Standard Specification for Flat Glass.

B. Sealed Insulating Glass Manufactures Association / Insulating Glass Certification Council (SIGMA / IGCC).

C. American Architectural Manufacturers Association / Window and Door Manufacturers Association (AAMA / WDMA):
   1. ANSI/AAMA/NWWDA 101 / I.S.2-97: Voluntary Specifications for Aluminum, (PVC) and Wood Windows and Glass Doors.
   2. 101/I.S. 2/NAFS-02: Voluntary Performance Specification for Windows, Skylights and Glass Doors/

D. Window and Door Manufacturers Association (WDMA): Hallmark Certification Program.

E. American Architectural Manufacturers Association (AAMA): 613: Voluntary Performance Requirements and Test Procedures for Organic Coatings on Plastic Profiles.

F. National Fenestration Rating Council (NFRC): 101: Procedure for Determining Fenestration Product Thermal Properties.

1.11 SYSTEM DESCRIPTION

A. Design and Performance Requirements:
   1. Window units shall be designed to comply with ANSI / AAMA / NWWDA 101 / I.S.2-97 and 101 / I.S. 2/ NAFS-02
      a. Single Hung: (H-LC50) (H-LC30)
      b. Transom: (TR-C50)
      c. Picture: (F-C50)
   2. Air leakage shall not exceed the following when tested at 1.57 according to ASTM E 283: .0.3 cfm per square foot of frame.
   3. No water penetration shall occur when units are tested at the following pressure according to ASTM E 547:
      a. Single Hung: (H-LC50 – 7.5 psf) (H-LC30 – 4.5 psf)
      b. Transom: (TR-C50-7.5 psf)

c. Picture: (F-C50-7.5 psf)

4. Units shall be designed to comply with ASTM E330 for structural performance when tested at the following pressures:
   a. Single Hung: (H-LC50 - 75 psf) (H-LC30 - 45 psf)
   b. Transom: (TR-C50-75 psf)
   c. Picture: (F-C50-75 psf)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufactuers:
   1. Ultrex as manufactured by Integrity Windows and Doors, Fargo, North Dakota.
   2. Impervia as manufactured by Integrity Windows and Doors, Fargo, North Dakota.
   3. Or architectural approved equal.

2.2 MATERIALS

2.1 FRAME DESCRIPTION

A. Interior: Reinforced fiberglass minimum 0.065 – 0.070 inch (2 mm) thick.

B. Frame width: Manufacturers' standard.

2.3 SASH DESCRIPTION

A. Manufactures' standard.

2.4 GLAZING

A. Select quality complying with ASTM C 1036. Insulating glass SIGMA/IGCC certified to performance level CBA when tested in accordance with ASTM E 774.

B. Glazing method: 3/4 inch (19 mm) Insulated glass.

C. Glass type: Low E II - Argon gas.

D. Glazing seal: Silicone bedding at exterior and interior.

2.5 FINISH

A. Color: Architect to choose from Manufacturers standard.

2.6 HARDWARE

A. Balance System: Coil spring block and tackle with nylon cord and glass filled nylon shoe and steel locking shoe.

B. Jamb Track: Pultrusion.

C. Lock: High pressure zinc die-cast cam lock and keeper.
   1. Finish: Phosphate coated and electrostatically painted. Color: White.

2.7 WEATHER STRIP

A. Sill weather strip is foam filled bulb. The bottom sash is sealed to the jambs using rigid with flexible seals. The top stationary sash seal is foam tape. The checkrails are sealed using rigid with flexible seals.

2.8 JAMB EXTENSION

A. Standard: 2". Furnish jamb extension: factory installed.

2.9 INSECT HALF SCREEN

A. Factory installed half screen. Screen mesh, 18 by 16: Charcoal fiberglass.

B. Frame finish: match windows.

2.10 GRILLES-BETWEEN-THE-GLASS (GBG)

A. Manufactures' standard
   1. Colors: match windows.

2.11 ACCESSORIES AND TRIM

A. Installation Accessories:
   1. Factory installed nailing fin at head, sill and side jambs.
   2. Installation brackets: Brackets for 4-9/16 inch (116 mm); 6-9/16 inch (167 mm) jambs.
   3. Sheet rock return.
   4. J-channel.
   5. Mullion kit: per drawing.

2.13 INSECT SCREENS

A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on outside of window and provide for each operable exterior sash or ventilator.

   1. Provide Manufacturers standard screen

2.14 FABRICATION

B. Fabricate windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

C. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator, unless otherwise indicated.

1. Double-Hung and single hung Windows: Provide weather stripping only at horizontal rails of operable sash.

D. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than 0.062-inch- (1.6-mm-) thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Provide manufacturer's standard finish to match window units. Provide subframes capable of withstanding design loads of window units.

E. Factory-Glazed Fabrication: Except for light sizes in excess of 100 united inches (2500 mm width plus length), glaze windows in the factory where practical and possible for applications indicated. Comply with requirements in Division 08 Section "Glazing" and with AAMA/WDMA 101/I.S.2/NAFS.

F. Glazing Stops: Provide nailed or snap-on glazing stops coordinated with Division 08 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

G. Hardware: Mount hardware through double walls of extrusions or provide corrosion-resistant steel reinforcement complying with requirements for reinforcing members, or do both.

H. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight window installation.

1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76 mm) of opening.
3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 EXAMINATION

A. Verification of Conditions: Before Installation, verify openings are plumb, square, and of proper dimension as required in Section 01 71 00. Report frame defects or unsuitable conditions to the General Contractor before proceeding.

B. Acceptance of Conditions: Beginning of installation confirms acceptance of existing conditions.

3.2 INSTALLATION

A. Comply with Section 01 73 00.

B. Assemble and install window unit according to manufacturer's instructions and reviewed shop drawings.

C. Install sealant and related backing materials at perimeter of unit or assembly in accordance with Section 07 92 00 Joint Sealants. Do not use expansive foam sealant.

D. Install accessory items as required.

E. Use finish nails to apply wood trim and mouldings.

3.3 CLEANING

A. Remove visible labels and adhesive residue according to manufacturer's instructions.

B. Leave windows and glass in a clean condition. Final cleaning as required in Section 01 74 00.

3.4 PROTECTING INSTALLED CONSTRUCTION

A. Comply with Section 01 76 00.

B. Protect windows from damage by chemicals, solvents, paint, or other construction operations that may cause damage.

3.2 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 085313

SECTION 08710 – FINISH HARDWARE, ACCESS CONTROL, LOW VOLTAGE WIRING

PART 1 –GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.02 DESCRIPTION OF WORK

A. The work of this section includes, but is not limited to, the following:

1. Providing hardware for all doors, except doors provided with their own hardware.
2. Providing lock cylinders for all work requiring cylinders.
3. Providing the services of a qualified hardware consultant to prepare detailed schedules of hardware required for the project.
4. Provide all low voltage wire and wiring for access control system. Locate card access controller in Elec/Tele/IT Room 121.

1.03 RELATED WORK

A. Carefully examine all of the Contrast Documents for requirements which affect the work of this section. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 08100 – Hollow metal doors and frames; work requiring template coordination, metal astragals for fire-rated doors.
2. Section 08210 – Wood doors; work requiring template coordination, metal astragals for fire-rated doors.

1.04 INTENT

A. A major intent of the work of this section is to provide hardware for every door in the project, except as indicated, so that each door functions correctly for its intended use. Provide only hardware that complies with applicable codes and requirements of authorities having jurisdiction including requirements for barrier–free accessibility.

1.05 QUALITY ASSURANCE

A. Hardware supplier shall have in his employ one or more members of the Door and Hardware Institute to include at least one Certified Architectural Hardware Consultant in good standing, who shall be responsible for preparation of the Finish Hardware Schedule. This Consultant shall be acceptable to the Architect and is to ensure that the intent requirement of this specification is fulfilled, and certify that the work of this section meets or exceeds the requirements specified in this section and the requirements of authorities having jurisdiction.

B. Hardware supplier shall warrant and guarantee, in writing, that hardware supplied is free of defective material and workmanship. Supplier shall further warrant and guarantee for a period of one year from Owner's Use and Occupancy that the hardware shall function in a satisfactory manner without binding, collapse, or dislodging of its parts, provide the installation is made to the manufacturer's recommendations.

C. The hardware supplier shall repair of remedy, without charge, any defect of workmanship or material for which he is responsible hereunder.

1.06 SUBMITTALS

A. Submit the following in accordance with SECTION 01300-SUBMITTALS:

1. Schedule: Submit to the Architect six (6) copies of the complete hardware schedule within the fourteen (14) days after receipt of contract award. Submit therewith complete catalog cuts and descriptive data of all products specifically scheduled therein. No materials shall be ordered or templates issued until the hardware schedule has been approved by the Architect. Form and detail of hardware schedule shall be in vertical format in conformance to the door and hardware industry standards. All hardware sets shall be clearly cross-referenced to the hardware set numbers listed in the specifications.

2. Samples: If requested, submit to the Architect for approval, a complete line of samples as directed. Samples shall be plainly marked giving hardware number used in this specification, the manufacturer's numbers, types and sizes. The Architect will deliver approved samples to the project site to be stored. Samples will remain with the Architect until delivery of all hardware to the project is complete, after which time they will be turned over to the General Contractor for incorporation into the work.

3. Keying System Submission: Before cylinders are ordered, submit a complete proposed keying system for approval. This should be done after a keying meeting has been held with the owner's representative.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of hardware shall be made to the project by the Hardware Supplier in accordance with the instructions of the General Contractor.

B. The finish hardware shall be delivered to the jobsite and received there by the General Contractor. The General Contractor shall prepare a locked storage room with adequate shelving, for all hardware. The storage room shall be in a dry, secure area, and shall not include storage of other products by other trades.

C. The General Contractor shall furnish the Hardware Supplier with receipts for all hardware and accessory items received, and shall send copies of these receipts to the Architect, if requested.

1.08 REGULATORY REQUIREMENTS

A. Conform to all applicable codes. Provide all throws, projections, coatings, knurling, opening and closing forces, and other special functions required by State and Local Building Codes, and all applicable Handicap Code requirements.

B. For fire rated openings, provide hardware complying with NFPA 80 and NFPA 101 without exception. Provide only hardware tested by UL for the type and size of door installed and fire resistance rating required.

1.09 SPECIAL REQUIREMENTS

A. Hardware Supplier shall determine conditions and materials of all doors and frames for proper application of hardware.

B. The Hardware Schedule shall list the actual product series numbers. Bidders are required to follow the manufacturers' catalog requirement for the actual size of door closers, brackets and holders. All door opening sizes are as noted on the Door Schedule and all hardware shall be in strict accordance with requirements of height, width, and thickness.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

Hinges	McKinney Stanley	Scranton, PA New Britain, CT
Locksets	Schlage (No exception)	Colorado Springs, CO
Exit Devices	Von Duprin (No exception)	Indianapolis, IN
Door Closers	LCN (No exception)	Princeton, IL
Door Stop	Glynn Johnson Ives Rockwood	Indianapolis, IN New Haven, CT Rockwood, PA
Card Access System	Synergistics (No exception)	Natick, MA
Push/Pulls	Rockwood Burns Ives	Rockwood, PA Erie, PA New Haven, CT
Protective Plates	Rockwood Burns Ives	Rockwood, PA Erie, PA New Haven, CT
Thresholds/ Weatherstripping/ Rain Drips	NGP Pemko Reese	Memphis, TN Memphis, TN Rosemount, MN
Silencers	Ives Glynn Johnson Rockwood	New Haven, CT Indianapolis, IN Rockwood, PA
Auto Operators	Horton Operators	Corpus Christi, TX

2.02 MATERIALS AND QUALITY

A. All hardware shall be of the best grade of solid metal entirely free from imperfections manufacturer and finish.

B. Qualities, weights, and sizes given herein are the minimum that will be accepted. It is the responsibility of the Hardware Supplier to supply the specified size and weight of hardware and the proper function of hardware in each case and to provide UL approved hardware at all fire rated doors.

C. Provide, as far as possible, locks of one lock manufacturer and hinges of one hinge manufacturer. Modifications to hardware that are necessary to conform to construction shown or specified shall be provided as required for the specified operation and functional features.

2.03 HARDWARE DESIGNATIONS

A. All items of hardware are referenced by manufacturer's names and numbers. The manufacturer's names and numbers are used to define the function, design, and the quality of the material to be supplied.

Substitution of products other than those listed shall be submitted to the Architect at least ten (10) days PRIOR to the bid date. The Architect shall be the sole judge of any proposed substitution.

2.04 TEMPLATES

A. Hardware supplier shall immediately, but not later than three (3) days after approval of his Schedule by the Architect, furnish the General Contractor with complete template information necessary for the fabrication of doors, frames, etc. No templates shall be furnished prior to the approval of the hardware schedule.

2.05 HARDWARE FOR LABELED FIRE DOORS, EXIT DEVICES AND SMOKE DOORS

A. Hardware shall conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Labeling and listing by UL Building Materials Directory, for class of door being used will be accepted as evidence of conformance to these requirements. Install minimum latch throw as specified on label of individual doors. Provide hardware listed by UL except where heavier materials, larger sizes, or better grades are specified herein under paragraph entitled "Hardware Sets". In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may b e submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA requirements. Specific hardware requirements of door or frame manufacturers which exceed sized or weights of hardware herein listed shall be provided with no additional charge.

2.06 KEYS AND KEYING

A. The hardware supplier shall review the specific hardware functions with the Architect and owner at the time of the keying review, to assure the appropriateness of each of the hardware functions. Failure to make this review does not relieve the hardware supplier from providing the proper functions.

B. Key System: All cylinders shall be Masterkeyed and/or Grandmaster Keys: Furnish six (6) keys for each set, if required.

1. Master keys, Grandmaster Keys: Furnish six (6) keys for each set, if required.

2. Furnish three (3) change keys for each cylinder keyed differently; six (6) change keys for each set keyed alike, and in sets where only (2) cylinders are keyed alike, four (4) change keys will be required.

3. All keying is to be done at the factory to avoid duplication of the new cylinders.

4. Master Keys shall be sent to the Owner by registered mail, return receipt required.

5. Supply a bitting list for all change keys and master keys to the Owner.

6. All lock cylinders shall be set to Construction key for use by the Contractor during the construction period. Furnish ten (10) Construction keys and two (2) voiding the Construction key feature.

7. All cylinders to be Small Format Interchangeable Core Schlage Everest "B" Family Restricted Keyway Cores.

2.07 FASTENERS

A. Manufacture hardware to conform to published templates, generally prepared for machine screw installation.

B. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Furnish exposed screws to match the hardware finish, or, if exposed in surfaces of other work, to match the finish of such other work as closely as possible, except as otherwise indicated.

C. Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard manufactured units of the type specified are available with concealed fasteners. Do not use thru-bolts unless specifically approved by the Architect.

D. All hardware shall be installed only with fasteners supplied by manufacturers of specific products.

2.08 PACKING AND MARKING

A. All hardware shall have the required screws, bolts and fastenings necessary for proper installation and shall be wrapped in the same package as the hardware item for which it is intended and shall match finish of hardware with which to be used.

B. Each package shall be clearly labeled indicating the portion of the work for which it is intended.

2.09 ENVIROMENTAL CONCERN FOR PACKGING

A. The hardware shipped to the jobsite is to be packaged in biodegradable packs such as paper or cardboard boxes and wrapping. If non-biodegradable packing such as plastic, plastic bags or large amounts of Styrofoam is utilized, then the Contractor will be responsible for the disposal of the non-biodegradable packing to a licensed or authorized collector for recycling of the non-degradable packing.

2.10 FINISH HARDWARE DESCRIPTION

A. Hardware items shall conform to respective specifications and standards and to requirements specified herein.

B. MATERIALS AND FINISH MATERIALS AND FINISHES SHALL BE:

1. Interior Butts: US26D (BHMA 652)
2. Exterior Geared Hinges US28 (BHMA 628)
3. Door Closers: Sprayed to match hardware finish.
4. Exit Devices: US26D (BHMA 626)
5. Kick, Push Plates: US32D (BHMA 630)
6. All other hardware shall be: US26D (BHMA 626), or as scheduled.

C. HINGES

1. Number of hinges per door, two hinges for doors up to and including five feet in height and an additional hinge for each two and one half feet or fraction thereof.

2. Hinges shall be as follows:

Exterior	McKinney	TA2314	4 ½ x 4 ½ NRP
	Stanley	FBB191	4 ½ x 4 ½ NRP
Interior	McKinney	TA2714	4 ½ x 4 ½
	Stanley	FBB179	4 ½ x 4 ½
Elec	McKinney	TA2714-CC4	
	Stanley	CEFBB179	

D. DOOR CLOSERS:

1. Door closers shall have fully hydraulic, full rack and pinion action. Cylinder body shall be 1-1/2” in diameter, and double heat treated pinion shall be 11/16” in diameter.

2. Hydraulic fluid shall be of a type requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.

3. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for physically handicapped. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and hydraulic back-check.

4. All closers shall have solid forged steel main arms (and forged forearms for parallel arm closers).

5. Closer arms (and metal covers when specified) shall have a powder coating finish.

6. Provide drop, mounting plates, where required.

7. Do not locate closers on the side of doors facing corridors, passageways or similar type areas. Where it is necessary, due to certain conditions and approval of the Architect, to have closers in corridors, provide such closers with parallel or track type arms.

8. All door closers shall be adjusted by the installer in accordance with the manufacturer's templates and written instructions. Closers with parallel arms shall have back-check features adjusted prior to installation.

9. Closers shall conform to all applicable code requirements relative to setting closing speeds for closers and maximum pressure for operating interior and exterior doors.

10. Shall be LCN, no exception:

	LCN
Exterior	4111S-CUSH
	4111S-H-CUSH
Interior	4011
	4111
	4040SE
	4000T
	4310ME-SF
	4040SE-DE

E. EXIT DEVICES:

1. Shall be Von Duprin, no exception:

Function	Von Duprin
A	CD99NL-OP
B	CD99EO
C	99L-2
D	99L-F-2
E	99NL-F
F	99L-F
G	99L-F-BE
H	9927EO
I	9927L
J	9927L-BE
K	CD9927EO x LBR
L	9927L x LBR
M	9927L-BE x LBR
N	CD99271F
O	9927L-F
P	9927L-F-BE
Q	9927EO-F x LBR
R	9927L-F x LBR
S	9927L-F-BE x LBR
T	QEL 9927TL
U	QEL 99L-F
V	QEL 99NL-OP
W	99L
X	QEL 99L-2

NOTE: Lever design shall match lock trim

F. HEAVY DUTY LEVER HANDLE CYLINDRICAL LOCKS:

1. Locksets for this project shall be heavy duty cylindrical key-in-lever handle type locksets.

2. Locksets shall be 2 ¾" backset with ½" throw latchbolt, with deadlocking latch, and a cylindrical housing of steel with a zinc dichromate finish.

3. Locksets shall be fastened by thru-bolts, thru the 3 ½" diameter inside rose back plate into the threaded studs in the outside rose back plate. Thru-bolts shall be placed in separate bolt holes, thru the door and outside the cylindrical case at 180 deg. from each other.

4. The inside and outside rose scalps shall be 3 ½"diameter wrought brass or bronze. When assembled, all thru-bolts in the face of the door shall be concealed from view. The lever handles shall be solid cast in the same finish as the rose.

5. Cylinders to be small format interchangeable core Schlage Everest "B" Family Restricted keyway cores and is also completely compatible with Best.

6. The ½' throw latchbolt shall be listed and approved for use by Underwriters Laboratories.

7. Strikes shall be curved lip ANSI A115.2 4 7/8" x 1 ¼" wrought brass or bronze.

8. The following locksets shall be considered acceptable for this project:

Schlage	"ND" Series	ATH Design	No exception

9. Include all permanent and construction cores.

10. Lock functions as indicated in the hardware schedule shall be as follows:

Function	Schlage	
A(Storeroom)	80	
B(Storeroom)	80	(Knurled Outside Lever)
C(Office)	50	
D(Passage)	10	
E(Vestibule)	60	
F(Classroom)	70	
G(Spec Classroom)	71	
H(Privacy)	40	
I(Apt Entrance)	53	
J(Elec)	96PDEU	(Fail Secure w/RX Switch)

G. DEADLOCKS:

Where called for in the hardware sets provide deadlocks as follows:

Function	Schlage
I (Classroom)	63

H. PUSH PLATES, DOOR PULLS, PUSH/PULL BARS:

1. Shall be as manufactured by Rockwood, Burns or Ives.

   a. Push plates shall be 4" x 16" x .050 thickness unless otherwise listed in hardware sets.

Rockwood	70 Series
Burns	50 Series
Quality	40 Series

b. Door pulls shall be 1” x 10”

Type A

Rockwood BF157

c. Push/pull bars

Type A (Wide Stile Doors)

Rockwood	BF11147 x T1006 Mounting
Burns	BF26C x 442 x Sim. Mounting as Above
Quality	BF 482 x Sim. Mounting as Above

I. KICK PLATES, ARMOR PLATES, MOP PLATES:

1. Kick plates shall be 8 in. high. Armor plates shall be 34 in. high. Mop plates shall be 4 in. high. All plates shall be 2 in. less the width of door. Plates shall be .050 thickness, bevel 4 edges, screws shall be oval head counter-sunk.

J. STOPS

1. Shall be furnished at all doors. Wherever and opened door or any item of hardware thereon strikes a wall, at 90 degrees. Provide wall bumpers, unless otherwise indicated in hardware sets.

2. Where wall bumpers cannot be effectively used, a floor stop shall be furnished and installed.

3. Provide roller bumpers for each door where two doors interfere with each other in swinging.

Manufacturer	Wall Bumpers	Floor Stops	Roller Bumpers
Rockwood	409	440, 442	456
Ives	407 ½	436B, 438B	470 Series
Glynn Johnson	WB 50XT	FB13, FB14	RB-3

4. Where overhead stops are listed they shall be the surface mounted type as follows:

Manufacturer	Series
Glynn Johnson	GJ450
Sargent	1540
ABH	4400

K. THRESHOLDS, WEATHERSTRIP, SEAL:

1. Thresholds shall be as detailed and furnished on all doors where shown on drawings. Thresholds shall be aluminum unless otherwise indicated. Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section “Joint Sealants”.

2. Weatherstripping shall be furnished on all exterior doors unless otherwise indicated.

Product	Pemko	Reese	NGP
Threshold	as detailed		
Brush Seal	45062AP	970	A626A
Auto. Door Bottom	430CR	330	420
Door Sweep	345AV	353	101AV
Set Astragals	351C x 351CP	95 x 95P	140 x 140P
Astragal	357SP	183S	139SP
Rain Drip	346C	R210A	16A

L. ACCESS CONTROL SYSTEM:

The access control system shall be WAPAC for windows manufactured by Synergistics, Inc. of Natick, MA, no exception. The controller shall be a CC1065NW located in Data Room 010. The readers shall be mag stripe insertion type, appropriate for the particular application and compatible with the University’s existing cards.

M. POWER SUPPLY:

Provide Von Duprin PS904

N. LOW-ENERGY OPERATOR:

Provide Horton 4100LE low energy operator. Push button switches to be wireless type radio control unit. Provide MC-25 interface switch for all operators with card access control.

O. ELECTROMAGNETIC DOOR RELEASES:

Provide wall mounted mag hold opens equal to Rixson model #FM998.

PART 3—EXECUTION

3.01. INSPECTION

1. It shall be the general contractors responsibility to inspect all doors openings and doors to determine that each door and door frame has been properly prepared for the required hardware. If errors in dimensions or preparation are encountered, they are to be corrected by the responsible parties prior to the installation of hardware.

3.02 PREPARATION

1. All doors and frames, requiring field preparation for finish hardware, shall be carefully mortised, drilled for pilot holes, or tapped for machine screws for all items of finish hardware in accordance with the manufacturers templates and instructions.

3.03 INSTALLATION/ADJUSTMENT/LOCATION

1. All materials shall be installed in a workmanlike manner following the manufacture's recommended instructions.

2. Exit Devices shall be carefully installed so as to permit friction free operation of crossbar, touch bar, lever. Latching mechanism shall also operate freely without friction or binding.

3. Door Closers shall be installed in accordance with the manufacturer's instructions. Each door closer shall be carefully installed, on each door, at the degree of opening indicated on the hardware schedule. Arm position shall be shown on the instruction sheets and required by the finish hardware schedule.

4. The adjustments for all door closers shall be the installer's responsibility and these adjustments shall be made at the time of installation of the door closer. The closing speed and the latching speed valves, shall be adjusted individually to provide a smooth, continuous closing action without slamming. The delayed action feature or back check valve shall also be adjusted so as to permit the correct delayed action cycle or hydraulic back check valve shall also be adjusted so as the opening cycle. All valves must be properly adjusted at the time of installation. Each door closer has adjustable spring power capable of being adjusted, in the field from size 2 thru 6. It shall be the installers' responsibility to adjust the spring power for each door closer in exact accordance with the spring power adjustment chart illustrated in the door closer installation sheet packed with each door closed.

5. Installation of all other hardware, including locksets, push-pull latches, overhead holders, door stops, plates and other items, shall be carefully coordinated with the hardware schedule and the manufacturer's instruction sheets.

6. Locations for finish hardware shall be in accordance with dimensions listed in the pamphlet "Recommended locations for Builders' Hardware" published by the Door and Hardware Institute.

3.04 FIELD QUALITY CONTROL

1. Upon completion of the installation of the finish hardware, it shall be the responsibility of the finish hardware supplier to visit the project and to examine the hardware for each door on which he has provided hardware and to verify that all hardware is in proper working order. Should he find items of hardware not operating problem he should make a report, in writing, to the general contractor, advising him of the problem and the measures required to correct the problem.

3.05 PROTECTION

1. All exposed portions of finish hardware shall be carefully protected, by use of cloth, adhesive backed paper or other materials, immediately after installation of the hardware item on the door. The finish shall remain protected until completion of the project. Prior to acceptance of the project by the Architect and owner, the general contractor shall remove the protective material exposing the finish hardware.

3.06 CLEANING

1. It shall be the responsibility of the general contractor to clean all items of finish hardware and to remove any remaining pieces of protective materials and labels.

3.07 INSTRUCTIONS AND TOOLS

1. It shall be the responsibility of the finish hardware supplier to provide installation and repair manuals and adjusting tools, wrenches, etc… for the following operating products.

    a. Locksets (all types)
    b. Exit Devices (all types)
    c. Door Closers

3.08 HARDWARE SETS

1. Each Hardware Set listed below represents the complete hardware requirements for one opening. (Single Door or Pair of Doors). Furnish the quantities required for each set for the work.

EXTERIOR SHELL

HW 1

Doors #002A, 005A, 006A, 006B, 137A
Each Leaf Shall Have: Hinges, Lockset (Function B), Door Closer, Kick Plate, Door Stop

HW 2

Doors #001A, 004A
Each Leaf Shall Have: Hinges, Lockset (Function A), Door Closer, Kick Plate, Door Stop

HW 3

Doors #101B
Each Leaf Shall Have: Hinges, Exit Device (Function B), Door Closer (Cush N Stop Arm), Kick Plate, Threshold, Weatherstrip, Door Sweep

HW 4

Door #138A
Each Leaf Shall Have: Hinges, (1) Electrical Hinge, Lockset (Function J), Flush Bolts, Door Closer (Cush N Stop Arm), Threshold, Weatherstrip, Door Sweeps, Astragal, Card Reader, Power Supply

HW 5

Door #100A
Each Leaf Shall Have: Hinges, Exit Device (Function H, T), Auto Operator, EPT Power Transfer, Door Closer (Cush N Stop Arm), Drop Plate, Pulls (Type A), Threshold, Power Supply (Balance of Hardware by Alum Door Supplier)

HW 6

Door #135A
Each Leaf Shall Have: Hinges, Exit Device (Function H, T), Auto Operator, EPT Power Transfer, Door Closer (Cush N Stop Arm), Drop Plate, Pulls (Type A), Threshold, Power Supply, Card Reader
(Balance of Hardware by Alum Door Supplier)

HW 7

Doors #101A, 135B, 201A
Each Leaf Shall Have: Hinges, Exit Device (Function F), Door Closer, Kick Plate, Door Stop

HW 8

Door #226A
Each Leaf Shall Have: Hinges, Exit Device (Function U), Door Closer, Kick Plate, Door Stop, Power Supply, Card Reader, EPT Power Transfer

HW 9

Door #100B
Each Leaf Shall Have: Hinges, Push Pull Bars, Door Closers, Kick Plates, Door Stops

HW10

Elevator A
Each Leaf Shall Have: Card Reader
(Balance of Hardware by Door Supplier)

INTERIOR FIT UP

HW 1

Doors #116A, 117A, 120A, 180A, 242A, 223A
Each Leaf Shall Have: Hinges, (1) Electric Hinge, Lockset (Function J), Door Closer, Kick Plate, Door Stop, Card Reader, Power Supply

HW 2

NOT USED

HW 3

Door #123A
Each Leaf Shall Have: Hinges, Exit Device (Function X), Door Closer, Kick Plate, Door Stop, Card Reader, EPT Power Transfer, Power Supply, Thumb Turn Cylinder

HW 4

Doors #108A, 109A, 207A, 208A
Each Leaf Shall Have: Hinges, Push Plate, Pull, Door Closer, Kick Plate, Door Stop

HW 5

Doors #134A, 134B, 123B
Each Leaf Shall Have: Hinges, Exit Device (Function D), Door Closer, Kick Plate, Door Stop, Thumb Turn Cylinder

HW 6

Doors 120B, 131A
Each Leaf Shall Have: Hinges, Lockset (Function A), Door Closer, Kick Plate, Door Stop

HW 7

Doors #131B, 222C, 229A
Each Leaf Shall Have: Hinges, Lockset (Function B), Door Closer, Door Stop

HW 8

Doors #132A, 209A, 210A, 240A
Each Leaf Shall Have: Hinges, Lockset (Function A), Door Stop

HW 9

Doors #114A
Each Leaf Shall Have: Hinges, Exit Device (Function W), Door Closer, Kick Plate, Door Stop

HW 10

Doors #129A, 130A, 220A, 221A
Each Leaf Shall Have: Hinges, Lockset (Function H), Door Closer, Kick Plate, Door Stop

HW 11

Doors #105A, 139A, 222A, 225A, 230A, 180B
Each Leaf Shall Have: Hinges, Lockset (Function C), Door Closer, Kick Plate, Door Stop

HW 12

Doors #103A, 106A, 118A
Each Leaf Shall Have: Hinges, Lockset (Function D), Door Stop

HW 13

Doors #106B, 133A
Each Leaf Shall Have: Hinges, Lockset (Function D), Door Closer, Kick Plate, Door Stop

HW 14

Doors #113A, 113B, 113C, 113D, 113E, 115A, 124A, 125A, 142A, 143A, 144A, 145A, 146A, 147A, 202A, 203A, 212A, 216A, 224A, 233A, 234A, 235A, 236A, 237A, 241A, 249A
Each Leaf Shall Have: Hinges, Lockset (Function C), Door Stop

HW 15

Door 104A
Each Leaf Shall Have: Pocket Door Frame, Sliding Door Lock (Baldwin 8595)

HW 16

Door #112A
Each Leaf Shall Have: Hinges, Lockset (Function D), Flush Bolts, Armor Plates, Overhead Stops

HW 17

Door #119A, 138C
Each Leaf Shall Have: Hinges, Lockset (Function C), Flush Bolts, Door Closer, Armor Plates, Door Stops

HW 18

Door #211A, 239A
Each Leaf Shall Have: Hinges, Lockset (Function C), Door Closer, Kick Plate, Door Stop, Magnetic Door Holder

HW 19

Doors #138B, 228A, 238A, 238B
Each Leaf Shall Have: Hinges, Lockset (Function B), Flush Bolts, Door Closer, Overhead Stop

HW 20

Doors #123B
Each Leaf Shall Have: Hinges, Exit Device (Function D), Door Closer, Kick Plate, Door Stop, Thumb Turn Cylinder

IPE CLINIC ALTERNATE
PORTLAND, ME

ADD ALTERNATE

HW A

Doors #166A, 165A, 164A, 150A, 151A, 152A
Each Leaf Shall Have: Hinges, Lockset (Function D), Door Stop

HW B

Doors #155A, 153A, 159A, 161A, 167A, 154A, 154B
Each Leaf Shall Have: Hinges, Lockset (Function C), Door Stop

HW C

Doors #158A, 160A
Each Leaf Shall Have: Hinges, Lockset (Function H), Door Stop

HW D

Doors #162A
Each Leaf Shall Have: Hinges, Lockset (Function C), Flush Bolts, Door Stops

SECTION 08710 – FINISH HARDWARE, ACCESS CONTROL, LOW VOLTAGE WIRING

PART 1 –GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.02 DESCRIPTION OF WORK

A. The work of this section includes, but is not limited to, the following:

1. Providing hardware for all doors, except doors provided with their own hardware.
2. Providing lock cylinders for all work requiring cylinders.
3. Providing the services of a qualified hardware consultant to prepare detailed schedules of hardware required for the project.
4. Provide all low voltage wire and wiring for access control system. Locate card access controller in Elec/Tele/IT Room 121.

1.03 RELATED WORK

A. Carefully examine all of the Contrast Documents for requirements which affect the work of this section. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 08100 – Hollow metal doors and frames; work requiring template coordination, metal astragals for fire-rated doors.
2. Section 08210 – Wood doors; work requiring template coordination, metal astragals for fire-rated doors.

1.04 INTENT

A. A major intent of the work of this section is to provide hardware for every door in the project, except as indicated, so that each door functions correctly for its intended use. Provide only hardware that complies with applicable codes and requirements of authorities having jurisdiction including requirements for barrier–free accessibility.

1.05 QUALITY ASSURANCE

A. Hardware supplier shall have in his employ one or more members of the Door and Hardware Institute to include at least one Certified Architectural Hardware Consultant in good standing, who shall be responsible for preparation of the Finish Hardware Schedule. This Consultant shall be acceptable to the Architect and is to ensure that the intent requirement of this specification is fulfilled, and certify that the work of this section meets or exceeds the requirements specified in this section and the requirements of authorities having jurisdiction.

B. Hardware supplier shall warrant and guarantee, in writing, that hardware supplied is free of defective material and workmanship. Supplier shall further warrant and guarantee for a period of one year from Owner's Use and Occupancy that the hardware shall function in a satisfactory manner without binding, collapse, or dislodging of its parts, provide the installation is made to the manufacturer's recommendations.

C. The hardware supplier shall repair of remedy, without charge, any defect of workmanship or material for which he is responsible hereunder.

1.06 SUBMITTALS

A. Submit the following in accordance with SECTION 01300-SUBMITTALS:

1. Schedule: Submit to the Architect six (6) copies of the complete hardware schedule within the fourteen (14) days after receipt of contract award. Submit therewith complete catalog cuts and descriptive data of all products specifically scheduled therein. No materials shall be ordered or templates issued until the hardware schedule has been approved by the Architect. Form and detail of hardware schedule shall be in vertical format in conformance to the door and hardware industry standards. All hardware sets shall be clearly cross-referenced to the hardware set numbers listed in the specifications.

2. Samples: If requested, submit to the Architect for approval, a complete line of samples as directed. Samples shall be plainly marked giving hardware number used in this specification, the manufacturer's numbers, types and sizes. The Architect will deliver approved samples to the project site to be stored. Samples will remain with the Architect until delivery of all hardware to the project is complete, after which time they will be turned over to the General Contractor for incorporation into the work.

3. Keying System Submission: Before cylinders are ordered, submit a complete proposed keying system for approval. This should be done after a keying meeting has been held with the owner's representative.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of hardware shall be made to the project by the Hardware Supplier in accordance with the instructions of the General Contractor.

B. The finish hardware shall be delivered to the jobsite and received there by the General Contractor. The General Contractor shall prepare a locked storage room with adequate shelving, for all hardware. The storage room shall be in a dry, secure area, and shall not include storage of other products by other trades.

C. The General Contractor shall furnish the Hardware Supplier with receipts for all hardware and accessory items received, and shall send copies of these receipts to the Architect, if requested.

1.08 REGULATORY REQUIREMENTS

A. Conform to all applicable codes. Provide all throws, projections, coatings, knurling, opening and closing forces, and other special functions required by State and Local Building Codes, and all applicable Handicap Code requirements.

B. For fire rated openings, provide hardware complying with NFPA 80 and NFPA 101 without exception. Provide only hardware tested by UL for the type and size of door installed and fire resistance rating required.

1.09 SPECIAL REQUIREMENTS

A. Hardware Supplier shall determine conditions and materials of all doors and frames for proper application of hardware.

B. The Hardware Schedule shall list the actual product series numbers. Bidders are required to follow the manufacturers' catalog requirement for the actual size of door closers, brackets and holders. All door opening sizes are as noted on the Door Schedule and all hardware shall be in strict accordance with requirements of height, width, and thickness.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

Hinges	McKinney Stanley	Scranton, PA New Britain, CT
Locksets	Schlage (No exception)	Colorado Springs, CO
Exit Devices	Von Duprin (No exception)	Indianapolis, IN
Door Closers	LCN (No exception)	Princeton, IL
Door Stop	Glynn Johnson Ives Rockwood	Indianapolis, IN New Haven, CT Rockwood, PA
Card Access System	Synergistics (No exception)	Natick, MA
Push/Pulls	Rockwood Burns Ives	Rockwood, PA Erie, PA New Haven, CT
Protective Plates	Rockwood Burns Ives	Rockwood, PA Erie, PA New Haven, CT

Thresholds/	NGP	Memphis, TN
Weatherstripping/	Pemko	Memphis, TN
Rain Drips	Reese	Rosemount, MN
Silencers	Ives	New Haven, CT
	Glynn Johnson	Indianapolis, IN
	Rockwood	Rockwood, PA
Auto Operators	Horton Operators	Corpus Christi, TX

2.02 MATERIALS AND QUALITY

A. All hardware shall be of the best grade of solid metal entirely free from imperfections manufacturer and finish.

B. Qualities, weights, and sizes given herein are the minimum that will be accepted. It is the responsibility of the Hardware Supplier to supply the specified size and weight of hardware and the proper function of hardware in each case and to provide UL approved hardware at all fire rated doors.

C. Provide, as far as possible, locks of one lock manufacturer and hinges of one hinge manufacturer. Modifications to hardware that are necessary to conform to construction shown or specified shall be provided as required for the specified operation and functional features.

2.03 HARDWARE DESIGNATIONS

A. All items of hardware are referenced by manufacturer's names and numbers. The manufacturer's names and numbers are used to define the function, design, and the quality of the material to be supplied.

Substitution of products other than those listed shall be submitted to the Architect at least ten (10) days PRIOR to the bid date. The Architect shall be the sole judge of any proposed substitution.

2.04 TEMPLATES

A. Hardware supplier shall immediately, but not later than three (3) days after approval of his Schedule by the Architect, furnish the General Contractor with complete template information necessary for the fabrication of doors, frames, etc. No templates shall be furnished prior to the approval of the hardware schedule.

2.05 HARDWARE FOR LABELED FIRE DOORS, EXIT DEVICES AND SMOKE DOORS

A. Hardware shall conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Labeling and listing by UL Building Materials Directory, for class of door being used will be accepted as evidence of conformance to these requirements. Install minimum latch throw as specified on label of individual doors. Provide hardware listed by UL except where heavier materials, larger sizes, or better grades are specified

herein under paragraph entitled “Hardware Sets”. In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may b e submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA requirements. Specific hardware requirements of door or frame manufacturers which exceed sized or weights of hardware herein listed shall be provided with no additional charge.

2.06 KEYS AND KEYING

A. The hardware supplier shall review the specific hardware functions with the Architect and owner at the time of the keying review, to assure the appropriateness of each of the hardware functions. Failure to make this review does not relieve the hardware supplier from providing the proper functions.

B. Key System: All cylinders shall be Masterkeyed and/or Grandmaster Keys: Furnish six (6) keys for each set, if required.

1. Master keys, Grandmaster Keys: Furnish six (6) keys for each set, if required.

2. Furnish three (3) change keys for each cylinder keyed differently; six (6) change keys for each set keyed alike, and in sets where only (2) cylinders are keyed alike, four (4) change keys will be required.

3. All keying is to be done at the factory to avoid duplication of the new cylinders.

4. Master Keys shall be sent to the Owner by registered mail, return receipt required.

5. Supply a bitting list for all change keys and master keys to the Owner.

6. All lock cylinders shall be set to Construction key for use by the Contractor during the construction period. Furnish ten (10) Construction keys and two (2) voiding the Construction key feature.

7. All cylinders to be Small Format Interchangeable Core Schlage Everest “B” Family Restricted Keyway Cores.

2.07 FASTENERS

A. Manufacture hardware to conform to published templates, generally prepared for machine screw installation.

B. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Furnish exposed screws to match the hardware finish, or, if exposed in surfaces of other work, to match the finish of such other work as closely as possible, except as otherwise indicated.

C. Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard manufactured units of the type specified are available with concealed fasteners. Do not use thru-bolts unless specifically approved by the Architect.

D. All hardware shall be installed only with fasteners supplied by manufacturers of specific products.

2.08 PACKING AND MARKING

A. All hardware shall have the required screws, bolts and fastenings necessary for proper installation and shall be wrapped in the same package as the hardware item for which it is intended and shall match finish of hardware with which to be used.

B. Each package shall be clearly labeled indicating the portion of the work for which it is intended.

2.09 ENVIROMENTAL CONCERN FOR PACKGING

A. The hardware shipped to the jobsite is to be packaged in biodegradable packs such as paper or cardboard boxes and wrapping. If non-biodegradable packing such as plastic, plastic bags or large amounts of Styrofoam is utilized, then the Contractor will be responsible for the disposal of the non-biodegradable packing to a licensed or authorized collector for recycling of the non-degradable packing.

2.10 FINISH HARDWARE DESCRIPTION

A. Hardware items shall conform to respective specifications and standards and to requirements specified herein.

B. MATERIALS AND FINISH MATERIALS AND FINISHES SHALL BE:

1. Interior Butts: US26D (BHMA 652)
2. Exterior Geared Hinges US28 (BHMA 628)
3. Door Closers: Sprayed to match hardware finish.
4. Exit Devices: US26D (BHMA 626)
5. Kick, Push Plates: US32D (BHMA 630)
6. All other hardware shall be: US26D (BHMA 626), or as scheduled.

C. HINGES

1. Number of hinges per door, two hinges for doors up to and including five feet in height and an additional hinge for each two and one half feet or fraction thereof.

2. Hinges shall be as follows:

Exterior	McKinney	TA2314	4 ½ x 4 ½ NRP
	Stanley	FBB191	4 ½ x 4 ½ NRP

Interior	McKinney	TA2714	4 ½ x 4 ½
	Stanley	FBB179	4 ½ x 4 ½
Elec	McKinney	TA2714-CC4	
	Stanley	CEFBB179	

D. DOOR CLOSERS:

1. Door closers shall have fully hydraulic, full rack and pinion action. Cylinder body shall be 1-1/2" in diameter, and double heat treated pinion shall be 11/16" in diameter.

2. Hydraulic fluid shall be of a type requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.

3. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for physically handicapped. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and hydraulic back-check.

4. All closers shall have solid forged steel main arms (and forged forearms for parallel arm closers).

5. Closer arms (and metal covers when specified) shall have a powder coating finish.

6. Provide drop, mounting plates, where required.

7. Do not locate closers on the side of doors facing corridors, passageways or similar type areas. Where it is necessary, due to certain conditions and approval of the Architect, to have closers in corridors, provide such closers with parallel or track type arms.

8. All door closers shall be adjusted by the installer in accordance with the manufacturer's templates and written instructions. Closers with parallel arms shall have back-check features adjusted prior to installation.

9. Closers shall conform to all applicable code requirements relative to setting closing speeds for closers and maximum pressure for operating interior and exterior doors.

10. Shall be LCN, no exception:

	LCN
Exterior	4111S-CUSH
	4111S-H-CUSH
Interior	4011
	4111
	4040SE

4000T
4310ME-SF
4040SE-DE

E. EXIT DEVICES:

1. Shall be Von Duprin, no exception:

Function	Von Duprin
A	CD99NL-OP
B	CD99EO
C	99L-2
D	QEL 99L-2
E	99NL-F
F	99L-F
G	99L-F-BE
H	9927EO
I	9927L
J	9927L-BE
K	CD9927EO x LBR
L	9927L x LBR
M	9927L-BE x LBR
N	CD99271F
O	9927L-F
P	9927L-F-BE
Q	9927EO-F x LBR
R	9927L-F x LBR
S	9927L-F-BE x LBR
T	QEL 9927TL
U	QEL 99L-F
V	QEL 99NL-OP
W	99L

NOTE: Lever design shall match lock trim

F. HEAVY DUTY LEVER HANDLE CYLINDRICAL LOCKS:

1. Locksets for this project shall be heavy duty cylindrical key-in-lever handle type locksets.

2. Locksets shall be 2 ¾" backset with ½" throw latchbolt, with deadlocking latch, and a cylindrical housing of steel with a zinc dichromate finish.

3. Locksets shall be fastened by thru-bolts, thru the 3 ½" diameter inside rose back plate into the threaded studs in the outside rose back plate. Thru-bolts shall be placed in separate bolt holes, thru the door and outside the cylindrical case at 180 deg. from each other.

4. The inside and outside rose scalps shall be 3 ½"diameter wrought brass or bronze. When assembled, all thru-bolts in the face of the door shall be concealed from view. The lever handles shall be solid cast in the same finish as the rose.

5. Cylinders to be small format interchangeable core Schlage Everest "B" Family Restricted keyway cores and is also completely compatible with Best.

6. The ½' throw latchbolt shall be listed and approved for use by Underwriters Laboratories.

7. Strikes shall be curved lip ANSI A115.2 4 7/8" x 1 ¼" wrought brass or bronze.

8. The following locksets shall be considered acceptable for this project:

Schlage	"ND" Series	ATH Design	No exception

9. Include all permanent and construction cores.

10. Lock functions as indicated in the hardware schedule shall be as follows:

Function	Schlage	
A(Storeroom)	80	
B(Storeroom)	80	(Knurled Outside Lever)
C(Office)	50	
D(Passage)	10	
E(Vestibule)	60	
F(Classroom)	70	
G(Spec Classroom)	71	
H(Privacy)	40	
I(Apt Entrance)	53	
J(Elec)	96PDEU	(Fail Secure w/RX Switch)

G. DEADLOCKS:

Where called for in the hardware sets provide deadlocks as follows:

Function	Schlage
I (Classroom)	63

H. PUSH PLATES, DOOR PULLS, PUSH/PULL BARS:

1. Shall be as manufactured by Rockwood, Burns or Ives.

   a. Push plates shall be 4" x 16" x .050 thickness unless otherwise listed in hardware sets.

Rockwood	70 Series
Burns	50 Series
Quality	40 Series

b. Door pulls shall be 1” x 10”

Type A

Rockwood BF157

c. Push/pull bars

Type A (Wide Stile Doors)

Rockwood	BF11147 x T1006 Mounting
Burns	BF26C x 442 x Sim. Mounting as Above
Quality	BF 482 x Sim. Mounting as Above

I. KICK PLATES, ARMOR PLATES, MOP PLATES:

1. Kick plates shall be 8 in. high. Armor plates shall be 34 in. high. Mop plates shall be 4 in. high. All plates shall be 2 in. less the width of door. Plates shall be .050 thickness, bevel 4 edges, screws shall be oval head counter-sunk.

J. STOPS

1. Shall be furnished at all doors. Wherever and opened door or any item of hardware thereon strikes a wall, at 90 degrees. Provide wall bumpers, unless otherwise indicated in hardware sets.

2. Where wall bumpers cannot be effectively used, a floor stop shall be furnished and installed.

3. Provide roller bumpers for each door where two doors interfere with each other in swinging.

Manufacturer	Wall Bumpers	Floor Stops	Roller Bumpers
Rockwood	409	440, 442	456
Ives	407 ½	436B, 438B	470 Series
Glynn Johnson	WB 50XT	FB13, FB14	RB-3

4. Where overhead stops are listed they shall be the surface mounted type as follows:

Manufacturer	Series
Glynn Johnson	GJ450
Sargent	1540
ABH	4400

K. THRESHOLDS, WEATHERSTRIP, SEAL:

1. Thresholds shall be as detailed and furnished on all doors where shown on drawings. Thresholds shall be aluminum unless otherwise indicated. Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section “Joint Sealants”.

2. Weatherstripping shall be furnished on all exterior doors unless otherwise indicated.

Product	Pemko	Reese	NGP
Threshold	as detailed		
Brush Seal	45062AP	970	A626A
Auto. Door Bottom	430CR	330	420
Door Sweep	345AV	353	101AV
Set Astragals	351C x 351CP	95 x 95P	140 x 140P
Astragal	357SP	183S	139SP
Rain Drip	346C	R210A	16A

L. ACCESS CONTROL SYSTEM:

The access control system shall be WAPAC for windows manufactured by Synergistics, Inc. of Natick, MA, no exception. The controller shall be a CC1065NW located in Data Room 010. The readers shall be mag stripe insertion type, appropriate for the particular application and compatible with the University’s existing cards.

M. POWER SUPPLY:

Provide Von Duprin PS904

N. LOW-ENERGY OPERATOR:

Provide Horton 4100LE low energy operator. Push button switches to be wireless type radio control unit. Provide MC-25 interface switch for all operators with card access control.

O. ELECTROMAGNETIC DOOR RELEASES:

Provide wall mounted mag hold opens equal to Rixson model #FM998.

PART 3—EXECUTION

3.01. INSPECTION

1. It shall be the general contractors responsibility to inspect all doors openings and doors to determine that each door and door frame has been properly prepared for the required hardware. If errors in dimensions or preparation are encountered, they are to be corrected by the responsible parties prior to the installation of hardware.

3.02 PREPARATION

1. All doors and frames, requiring field preparation for finish hardware, shall be carefully mortised, drilled for pilot holes, or tapped for machine screws for all items of finish hardware in accordance with the manufacturers templates and instructions.

3.03 INSTALLATION/ADJUSTMENT/LOCATION

1. All materials shall be installed in a workmanlike manner following the manufacture's recommended instructions.

2. Exit Devices shall be carefully installed so as to permit friction free operation of crossbar, touch bar, lever. Latching mechanism shall also operate freely without friction or binding.

3. Door Closers shall be installed in accordance with the manufacturer's instructions. Each door closer shall be carefully installed, on each door, at the degree of opening indicated on the hardware schedule. Arm position shall be shown on the instruction sheets and required by the finish hardware schedule.

4. The adjustments for all door closers shall be the installer's responsibility and these adjustments shall be made at the time of installation of the door closer. The closing speed and the latching speed valves, shall be adjusted individually to provide a smooth, continuous closing action without slamming. The delayed action feature or back check valve shall also be adjusted so as to permit the correct delayed action cycle or hydraulic back check valve shall also be adjusted so as the opening cycle. All valves must be properly adjusted at the time of installation. Each door closer has adjustable spring power capable of being adjusted, in the field from size 2 thru 6. It shall be the installers' responsibility to adjust the spring power for each door closer in exact accordance with the spring power adjustment chart illustrated in the door closer installation sheet packed with each door closed.

5. Installation of all other hardware, including locksets, push-pull latches, overhead holders, door stops, plates and other items, shall be carefully coordinated with the hardware schedule and the manufacturer's instruction sheets.

6. Locations for finish hardware shall be in accordance with dimensions listed in the pamphlet "Recommended locations for Builders' Hardware" published by the Door and Hardware Institute.

3.04 FIELD QUALITY CONTROL

1. Upon completion of the installation of the finish hardware, it shall be the responsibility of the finish hardware supplier to visit the project and to examine the hardware for each door on which he has provided hardware and to verify that all hardware is in proper working order. Should he find items of hardware not operating problem he should make a report, in writing, to the general contractor, advising him of the problem and the measures required to correct the problem.

3.05 PROTECTION

1. All exposed portions of finish hardware shall be carefully protected, by use of cloth, adhesive backed paper or other materials, immediately after installation of the hardware item on the door. The finish shall remain protected until completion of the project. Prior to acceptance of the project by the Architect and owner, the general contractor shall remove the protective material exposing the finish hardware.

3.06 CLEANING

1. It shall be the responsibility of the general contractor to clean all items of finish hardware and to remove any remaining pieces of protective materials and labels.

3.07 INSTRUCTIONS AND TOOLS

1. It shall be the responsibility of the finish hardware supplier to provide installation and repair manuals and adjusting tools, wrenches, etc… for the following operating products.

   a. Locksets (all types)
   b. Exit Devices (all types)
   c. Door Closers

3.08 HARDWARE SETS

1. Each Hardware Set listed below represents the complete hardware requirements for one opening. (Single Door or Pair of Doors). Furnish the quantities required for each set for the work.

EXTERIOR SHELL

HW 1

Doors #002A, 005A, 006A, 006B, 137A
Each Leaf Shall Have: Hinges, Lockset (Function B), Door Closer, Kick Plate, Door Stop

HW 2

Doors #001A, 004A,
Each Leaf Shall Have: Hinges, Lockset (Function A), Door Closer, Kick Plate, Door Stop

HW 3

Doors #101B
Each Leaf Shall Have: Hinges, Exit Device (Function B), Door Closer (Cush N Stop Arm), Kick Plate, Threshold, Weatherstrip, Door Sweep

HW 4

Door #138B
Each Leaf Shall Have: Hinges, (1) Electrical Hinge, Lockset (Function J), Flush Bolts, Door Closer (Cush N Stop Arm), Threshold, Weatherstrip, Door Sweeps, Astragal, Card Reader, Power Supply

HW 5

Door #100A
Each Leaf Shall Have: Hinges, Exit Device (Function H, T), Auto Operator, EPT Power Transfer, Door Closer (Cush N Stop Arm), Drop Plate, Pulls (Type A), Threshold, Power Supply
(Balance of Hardware by Alum Door Supplier)

HW 6

Door #135A
Each Leaf Shall Have: Hinges, Exit Device (Function H, T), Auto Operator, EPT Power Transfer, Door Closer (Cush N Stop Arm), Drop Plate, Pulls (Type A), Threshold, Power Supply, Card Reader
(Balance of Hardware by Alum Door Supplier)

HW 7

Doors #101A, 135B, 201A
Each Leaf Shall Have: Hinges, Exit Device (Function F), Door Closer, Kick Plate, Door Stop

HW 8

Door #226A
Each Leaf Shall Have: Hinges, Exit Device (Function U), Door Closer, Kick Plate, Door Stop, Power Supply, Card Reader, EPT Power Transfer

HW 9

Door #100B
Each Leaf Shall Have: Hinges, Push Pull Bars, Door Closers, Kick Plates, Door Stops

HW10

Elevator A
Each Leaf Shall Have: Card Reader
(Balance of Hardware by Door Supplier)

INTERIOR FIT UP

HW 1

Doors #116A, 117A
Each Leaf Shall Have: Hinges, (1) Electric Hinge, Lockset (Function J), Door Closer, Kick Plate, Door Stop, Card Reader, Power Supply

HW 2

NOT USED

HW 3

Door #123A
Each Leaf Shall Have: Hinges, Exit Device (Function D), Door Closer, Kick Plate, Door Stop, Card Reader, EPT Power Transfer, Power Supply, Thumb Turn Cylinder

HW 4

Doors #108A, 109A, 123B, 207A, 208A
Each Leaf Shall Have: Hinges, Push Plate, Pull, Door Closer, Kick Plate, Door Stop

HW 5

Doors #134A, 134B
Each Leaf Shall Have: Hinges, Exit Device (Function C), Door Closer, Kick Plate, Door Stop, Thumb Turn Cylinder

HW 6

Doors 121A, 122A, 131A
Each Leaf Shall Have: Hinges, Lockset (Function A), Door Closer, Kick Plate, Door Stop

HW 7

Doors #121B, 229A
Each Leaf Shall Have: Hinges, Lockset (Function A), Door Closer, Door Stop

HW 8

Doors #132A, 209A, 210A, 238A, 238B, 240A
Each Leaf Shall Have: Hinges, Lockset (Function A), Door Stop

HW 9

Doors #114A
Each Leaf Shall Have: Hinges, Exit Device (Function W), Door Closer, Kick Plate, Door Stop

HW 10

Doors #129A, 130A, 220A, 221A

Each Leaf Shall Have: Hinges, Lockset (Function H), Door Closer, Kick Plate, Door Stop

HW 11

Doors #105A, 139A, 146A, 222A, 225A
Each Leaf Shall Have: Hinges, Lockset (Function C), Door Closer, Kick Plate, Door Stop

HW 12

Doors #103A, 106A, 118A, 222B, 222C
Each Leaf Shall Have: Hinges, Lockset (Function D), Door Stop

HW 13

Doors #106B, 133A
Each Leaf Shall Have: Hinges, Lockset (Function D), Door Closer, Kick Plate, Door Stop

HW 14

Doors # 113A, 113B, 113C, 115A, 119A, 119B, 120A, 124A, 124B, 125A, 142A, 143A, 144A, 145A, 147A, 180A, 180B, 202A, 203A, 212A, 216A, 223A, 224A, 225A, 233A, 234A, 235A, 236A, 237A, 241A, 242A, 248A, 249A
Each Leaf Shall Have: Hinges, Lockset (Function C), Door Stop

HW 15

Door 104A
Each Leaf Shall Have: Pocket Door Frame, Sliding Door Lock (Baldwin 8595)

HW 16

Door #112A
Each Leaf Shall Have: Hinges, Lockset (Function D), Flush Bolts, Armor Plates, Overhead Stops

HW 17

Door #138A
Each Leaf Shall Have: Hinges, Lockset (Function C), Flush Bolts, Door Closer, Armor Plates, Door Stops

HW 18

Door #211A
Each Leaf Shall Have: Hinges, Lockset (Function C), Door Closer, Kick Plate, Door Stop, Magnetic Door Holder

HW 19

Doors #228A, 239A
Each Leaf Shall Have: Hinges, Lockset (Function B), Flush Bolts, Door Closer, Overhead Stop

CORNELL

Rolling Counter Doors

Model ESC10

Practical Design Applications

- Service Window Openings
- Cafeterias
- Stadiums
- Arenas
- Hospitality/Public Space
- Educational Facilities
- Healthcare Facilities

Benefits

- Q/S Program - Cornell can manufacture and ship most standard counter doors in one to two weeks.
- Size Flexibility - each unit is built to exact opening size requirements.
- Compact Storage - curtain stores in an overhead coil that is totally supported by the side guides.
- Low Life Cycle Cost - rugged construction and commercial quality materials assure long life.
- Maintenance - little to none.
- Repairs - job records are retained and parts are readily available.

Available Options

- Cylinder or slide bolt locking
- Sill angles
- Fixed or removable mullions
- Special corner mullions
- 16 gauge extruded aluminum slat
- Bottom bar sensing edge for motorized units
- Operator covers for exterior mounted units or exposed operators below 8'-0" high

Specialty Counter Doors

Counter Doors with Frame and Countertop

Model ESC20

Integral frames are assembled and welded with 16 ga. stainless or steel material, countertops are 14 ga. stainless standard, with plastic laminate optional. Stainless material is 300 series #4 finish, steel frames are powder coated. These units are fully assembled and can be built into new openings or slip into existing openings.

ScreenGard™

22 gauge galvanized steel perforated counter door curtain slats provide full security while offering airflow and visual access. Ideal applications are public space corridors, for use in food preparation areas and for storefront protection.

Graphics Door

Durable, full color images applied to door curtains and hoods. Now, any of these surfaces can be utilized as an opportunity to advertise, create sponsorship opportunities, educate, inform or add aesthetic interest. Design possibilities are only limited by the imagination.

DRS
RP
Dri-Fit™

Rails
Headers
Glazing Systems

Innovation and quality made easy. DORMA DRS Rail System with Easi-Align™ and Dri-Fit™.

The DRS Rail System—the original clamp-on rail system from DORMA—allows for the easiest and quickest door assembly of any rail system on the market.

DRS Rails are delivered with all DORMA hardware installed and prepped. Simply clamp the rails onto a piece of tempered glass and the system is ready for installation. The DRS clamp-on system allows for job-site door height adjustment to compensate for irregularities in the door opening.

Additionally, the snap-on rail covers need not be installed until job inspection, keeping construction site damage to a minimum.

DORMA DRS Rails feature Easi-Align™ adjustable prep blocks for setting door clearances and pivot centers while the door is installed. With Easi-Align, one rail size—35-3/4" (908 mm)—can be used for openings of 36" (914 mm) or 72" (1829 mm). This feature reduces stocking requirements, shortens lead times, and simplifies ordering requirements.

Innovative design, quality materials, and the finest workmanship mean that the DRS Rail System has features to meet the most demanding conditions. The system has been independent-laboratory tested for holding force under any climate condition. Tested at temperatures ranging from –10° to 150°, the DORMA DRS rail pull tested for over 3000 lb (1364 kg) per 3' (914 mm) under the worst conditions, and for over 5000 lb (2273 kg) in the best conditions, all without failure or slippage.

Dri-Fit™ sidelite rails are offered to match door profiles, plus a complete range of saddles to match clearances.

For easy glazing that eliminates the need to use silicone during glass installation, top and bottom Dri-Fit U-channels are also available.

DRS system heights are:
- 3-5/8" (92 mm) —square or tapered
- 4" (102 mm)—square
- 6" (152 mm)—square
- 8" (203 mm)—square
- 10" (254 mm)—square

All heights accommodate 3/8" (10 mm) and 1/2" (12 mm) width glass.

3-5/8" (92 mm) and 6" (152 mm) systems can also accommodate 5/8" (15 mm) and 3/4" (19 mm) thick glass.

The DRS Rail System offers nine stock finishes (page 4). Custom finishes are also available.

DORMA DRS at a glance

- On-site height adjustability
- Snap-on covers
- On-site glass replacement
- Mechanical clamp-on system featuring the Hakosil gasket as utilized in DORMA Patch Fittings
- Doors can be prepared for a full range of DORMA architectural hardware
- Can be used in conjunction with the DORMA header system
- One-stop shopping for rails, sidelites, fittings, headers, and handles
- DORMA's worldwide reputation as an industry leader

Technical Data

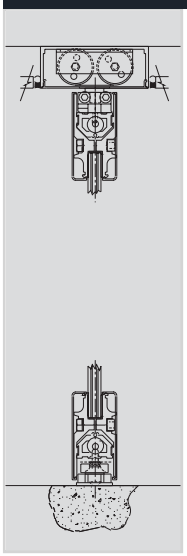
Glass thickness
3/8" (10 mm)
1/2" (12 mm)
5/8" (15 mm)
3/4" (19 mm)
(see table next page)

Max width
48" (1219 mm) w/ BTS floor closer
42" (1067 mm) w/ RTS overhead closer
(GANA guidelines)

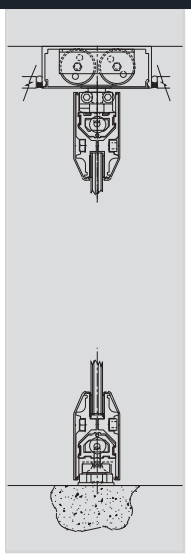
Warranty 1 year

Mechanical Rail Section Details

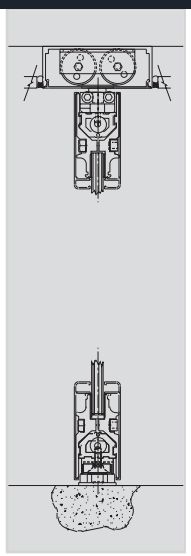
DRS Mechanical Rail Section Details



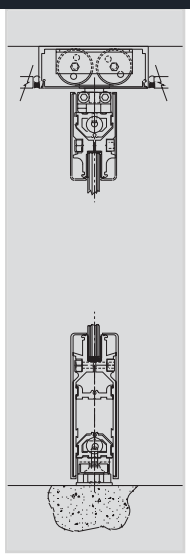
3-5/8" (92 mm)
Square
DRS Rail



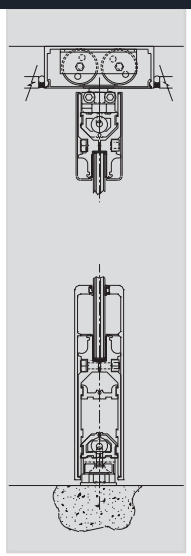
3-5/8" (92 mm)
Tapered
DRS Rail



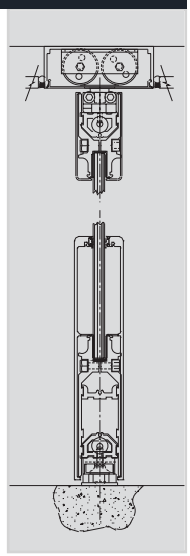
4" (102 mm)
Square
DRS Rail



6" (152 mm)
Square
DRS Rail



8" (203 mm)
Square
DRS Rail



10" (254 mm)
Square
DRS Rail

Glass Thickness Availability

Glass Thickness (fully tempered)	3-5/8" (92 mm) SQ DRS Rail	3-5/8" (92 mm) TP DRS Rail	4" (102 mm) SQ DRS Rail	6" (152 mm) SQ DRS Rail	8" (203 mm) SQ DRS Rail	10" (254 mm) SQ DRS Rail
3/8" (10 mm) or 1/2" (12 mm)	X	X	X	X	X	X
5/8" (15 mm) or 3/4" (19 mm)	X	X		X		

The DRS/RP/Dri-Fit system comes in nine stock finishes or custom finishes upon request.


Clear Anodized (101)


Dark Bronze Anodized (108)


Black Anodized (109)


Polished Stainless Steel (701)


Polished Brass (503)


Polished Bronze (601)

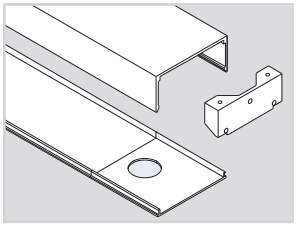

Satin Stainless (700)


Satin Brass (599)


Satin Bronze (600)

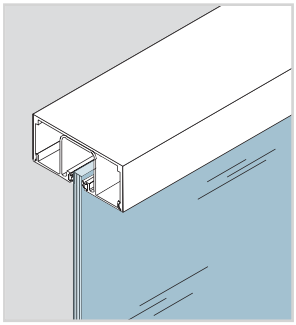
Invisible door control, dependable and ready to install. DORMA RP Headers.

Design professionals are often challenged to design buildings that are both beautiful and functional down to the last detail. DORMA RP header tubes are made to house the RTS overhead concealed closers and a variety of other pivot options.



The popularity of concealed overhead closers has led DORMA to furnish fully fabricated headers for every door and sidelite configuration. Headers are available in two profiles:

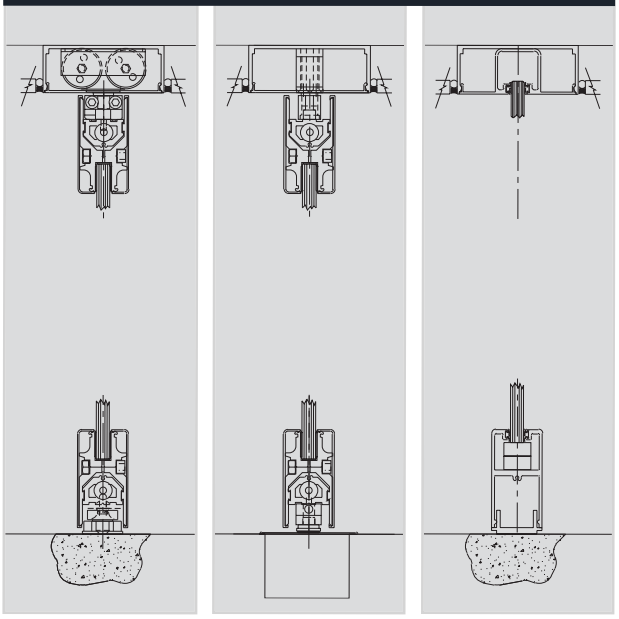
- 1-3/4" × 4-1/8" (44 mm × 105 mm)
- 1-3/4" × 4-1/2" (44 mm × 114 mm)



The design of the DORMA RP header system allows for a glazing pocket to be snapped into the header tube to permit a seamless transition to the sidelite glazing. The Dri-Fit gasket is used for quick and easy installation. Profiles are available for glass thicknesses of 3/8" (10 mm), 1/2" (12 mm), 5/8" (15 mm), and 3/4" (19 mm) tempered glass.

RP Header tubes are available in all nine standard finishes.

RP Header Section Details



4-1/8" (105 mm) Header with RTS closer installed

4-1/2" (114 mm) Header with 8062 pivot

4-1/2" (114 mm) Header with Dri-Fit glazing pocket

Simplified glazing, minimal hardware. DORMA Dri-Fit.

The DORMA Dri-Fit system simplifies glazing installation. The intelligently designed Dri-Fit gasket is used in sidelite rails, header tube glazing pockets, and u-channels.

Dri-Fit side rails are available to match all DRS mechanical profile heights and offer a number of saddle sizes from 1/8" to 3/4" (3 mm to 19 mm) tall.

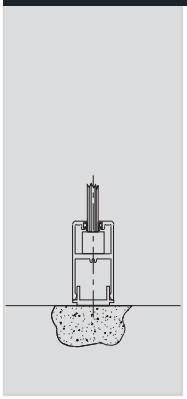
The Dri-Fit glazing system accommodates glass thicknesses of 3/8" (10 mm), 1/2" (12 mm), 5/8" (15 mm), and 3/4" (19 mm). See the table on page 7 for more details.

In addition to Dri-Fit sidelite rails, DORMA also offers the Dri-Fit U-Channel—a low profile u-channel ideal for glazing with minimal hardware. It can even be recessed in the ceiling and floor to completely eliminate visible hardware.

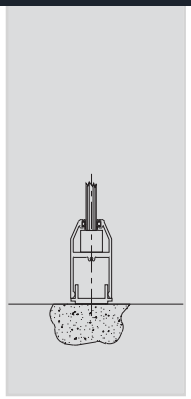
Both Dri-Fit sidelite rails and Dri-Fit U-Channels are available in all nine stock finishes (page 4). Extrusions are available in stock lengths up to 144" (3658 mm) [120" (3048 mm) for Brass and Bronze finishes].

The DORMA Dri-Fit system simplifies glazing installation.

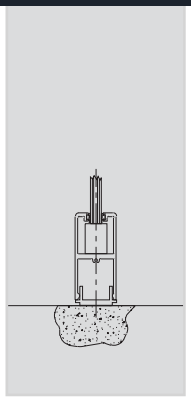
Dri-Fit Sidelite Rail Profiles



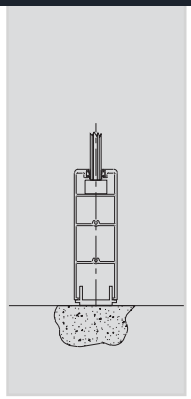
3-5/8" (92 mm)
Square
Dri-Fit Rail



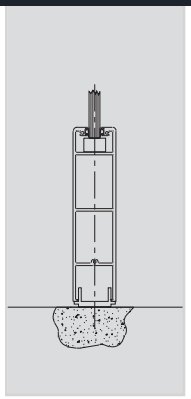
3-5/8" (92 mm)
Tapered
Dri-Fit Rail



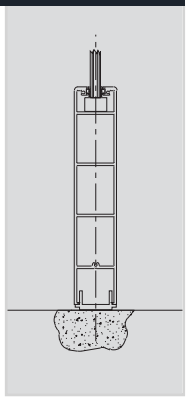
4" (102 mm)
Square
Dri-Fit Rail



6" (152 mm)
Square
Dri-Fit Rail

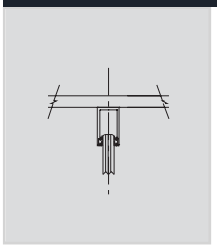


8" (203 mm)
Square
Dri-Fit Rail

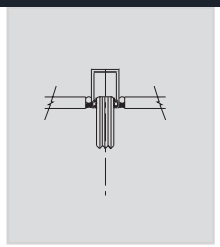


10" (254 mm)
Square
Dri-Fit Rail

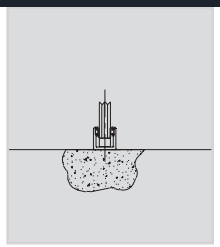
Dri-Fit U-Channel Profiles



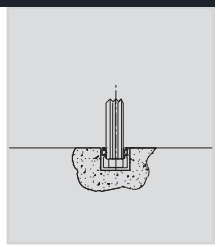
1" × 1-3/4"
(25 mm x 44 mm)
Top Dri-Fit
U-Channel
(shown flush mounted)



1-1/4" × 1-3/4"
(32 mm x 44 mm)
Top Dri-Fit
U-Channel
(shown recessed)



1" × 1"
(25 mm x 25 mm)
Bottom Dri-Fit
U-Channel
(shown flush mounted)



1-1/4" × 1"
(32 mm x 25 mm)
Bottom Dri-Fit
U-Channel
(shown recessed)

Glass Thickness Availability

Glass Thickness (fully tempered)	3-5/8" (92 mm) SQ Dri-Fit Rail	3-5/8" (92 mm) TP Dri-Fit Rail	4" (102 mm) SQ Dri-Fit Rail	6" (152 mm) SQ Dri-Fit Rail	8" (203 mm) SQ Dri-Fit Rail	10" (254 mm) SQ Dri-Fit Rail	1" × 1" (25 mm x 25 mm) Dri-Fit U-Channel	1" × 1-3/4" (25 mm x 44 mm) Dri-Fit U-Channel	1-1/4" × 1" (32 mm x 25 mm) Dri-Fit U-Channel	1-1/4" × 1-3/4" (32 mm x 44 mm) Dri-Fit U-Channel
3/8" (10 mm) or 1/2" (12 mm)	X	X	X	X	X	X	X	X		
5/8" (15 mm) or 3/4" (19 mm)	X	X		X					X	X

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Floor-Concealed
Door Closers

DORMA BTS75V

Dependable and Versatile Floor-Concealed Closer

The BTS75V Series of floor-concealed door closers offer adaptability to almost any installation.

The closer's compact body permits its use where a larger closer would be prohibitive. Versatility allows installation in thin slab concrete subfloor construction. A wide selection of interchangeable spindles makes the BTS75V suitable for virtually any floor covering or threshold application. Adjustable spring power from size 1–4 allows the necessary adjustment required for both barrier-free and non-barrier-free openings, giving ultimate installation flexibility.

Trouble-free performance under adverse climatic and traffic conditions makes the BTS75V floor-concealed closer dependable and a perfect choice for even the most rigorous applications. For total control and uncompromising creativity for any door opening, specify a BTS75V floor-concealed closer.

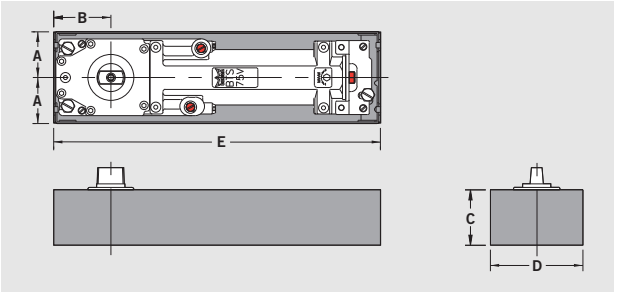
Features	BTS75V	BTS75V BF
Adjustable spring sizes	1–4	1–4
Non-handed unit suitable for both single- and double-acting doors	•	•
Controlled closing with two independent valves	175°–15° 15°–0°	175°–70° 70°–0°
Mechanical backcheck	•	-
Delayed action	-	•
Single point hold open available at 90°	○	○
Single point hold open available at 105°	○	-

• yes - no ○ option

Door Size Chart	
	Door Width
Interior	2'-0" (610 mm) to 3'-6" (1067 mm)
Exterior	2'-0" (610 mm) to 3'-0" (914 mm)

Maximum door widths shown are for average conditions. If there are unusual site conditions, e.g. high or exceptionally heavy doors or wind pressure, the door width should be reduced.

NOTE: Although DORMA BTS75V and BTS75V BF Series closers have adjustable spring power to compensate for site conditions, it can not be guaranteed that adequate control will be obtained while complying with interior or exterior barrier-free opening force restrictions.



	A	B	C	D	E
Inches	1-7/16–1-13/16	2–2-1/4	2	3-1/4	11-1/4
Millimeters	36–46	51–57	51	82	285

Certification:
The DORMA BTS75V and BTS75V BF non-hold open versions are listed by UL and CUL under their continuing reinspection programs. The DORMA BTS75V Series is certified to the requirements of ANSI/BHMA A156.4 for grade 1 closers. The BTS75V BF meets the opening force requirements of ANSI/BHMA A117.1 for barrier-free interior and exterior doors.

Specifications:
All floor-concealed door closers shall be DORMA BTS75V Series employing a cam and roller mechanism. The closers shall be capable of controlling doors weighing up to 260 pounds and measuring up to 3'-6" for interior doors and 3'-0" wide for exterior doors. The closers will have mechanical backcheck at approximately 70°. Dual valve adjustment will provide controlled closing speed from 175°–15° (sweep range) and 15°–0° (latch range), even in cold temperature conditions. The closer mechanism will provide adjustment within the cement case to allow 3/8" lateral, 1/4" longitudinal, and 5/32" vertical height adjustment. Field interchangeable spindles will be available to provide bottom door clearances ranging from 5/16" to 2-5/16".

Optional Specifications:
Floor-concealed door closers for all interior and exterior barrier-free openings shall be DORMA BTS75V BF. The closers shall be capable of maintaining a maximum opening force of 5 pounds through 90° of door swing on barrier free interior doors and 8.5 pounds on exterior barrier-free doors 3'-0" wide. The closers will have selectable delayed action standard without backcheck. The closers should be used with sealing compound SC-1 to prevent water or cleaning solvent from entering the cement case.

REDUCED OPENING FORCE INSTALLATIONS CAUTION:
Manual door closers, including closers certified to conform to ANSI/BHMA Standard A156.4, when installed and adjusted to conform to ADA or other reduced opening force requirements, may not provide sufficient power to reliably close and latch a door.

Refer to catalog for information on ED800 Low Energy Operator to meet reduced opening force requirements without affecting closing power.

Finishes:

Optional Plated Finishes:
Brass: 605 (Bright) or 606 (Satin).
Bronze: 611 (Bright), 612 (Satin), or
613 (Oxidized Satin Oil Rubbed).
Nickel: 618 (Bright) or 619 (Satin).
Chrome: 625 (Bright) or 626 (Satin).

Standard Sprayed Finishes:
Aluminum: 689.
Bronze: 691 (Dull), 690 (Statuary), or 695 (Dark Duranodic).
Gold: 696.
Black: 693.

Optional DORMA Custom Color or Designer Color Finishes:
Contact Customer Service.

Warranty: For details, refer to **Limited Warranty Policy** in the current DORMA Price List.

How to Order BTS75V Series		Example
Closer	BTS75V BTS75V BF **(barrier-free)** (see **BTS Applications and Accessories** brochure for specific handing of accessories and packages)	BTS75V BTS75V BF
Package	Center-pivoted double-acting aluminum door and frame	BTS75V/A
Body Option	Non-hold open 90° hold open 105° hold open	BTS75V - NHO BTS75V - 90° HO BTS75V - 105° HO
Accessories	Specify the number of the accessory (see **BTS Applications and Accessories** brochure)	SC-1
Spindle	74010 or 80010 are furnished standard unless otherwise specified (see Spindles on page 6)	BTS75V/A x 74025
Finish	Bright Brass	BTS75V/A (605)

BTS75V

Technical Details:

- Adjustable spring size 1–4.
- Can be installed and adjusted to meet 8.5 lb maximum opening force requirements for exterior doors.
- Compact closer body and cement case 2" deep suited for thin slab concrete construction.
- Closer body is non-handed.
- Accommodates doors weighing up to 260 lb and measuring up to 3'-6" wide interior and 3'-0" exterior.
- Mechanical backcheck at approximately 70°.
- Dual thermostatic control valves combined with special hydraulic fluid provide controlled closing from 175°.
- Optional single point hold open units available for 90° or 105°.
- A secondary regulation system protects closer from damage caused by forced closing.
- Closer adjustment in cement case provides 3/8" lateral, 1/4" longitudinal, and 5/32" height adjustment.
- Optional sealing compound SC-1 prevents water or cleaning solvent from entering the cement case.
- Optional accessory bracket available to convert a BTS75 cement case to accept a BTS75V.

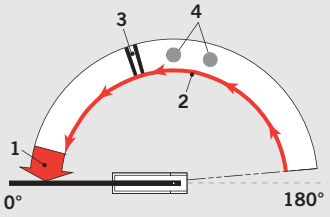
1 Valve adjustment 15°–0°.

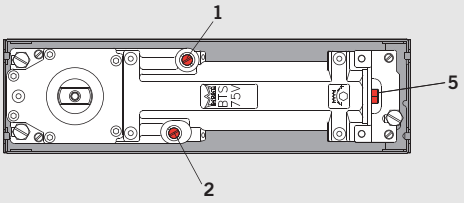
2 Valve adjustment 175°–15°.

3 Mechanical backcheck at approximately 70°.

4 Single point hold open units available at 90° or 105°.

5 Spring power adjustment.





BTS75V NHO
BTS75V BF NHO

- Non-hold open unit is U.L. listed for use with fire rated doors when door swing is limited to 175° with an auxiliary stop.

BTS75V BF

Technical Details:

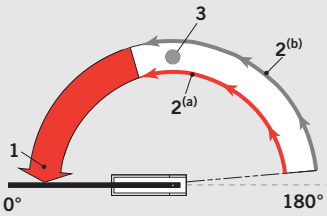
- Opening force 5 lb or less on interior doors/8.5 lb or less on exterior doors where door without closer attached is 1 lb opening force or less.
- Mechanical backcheck eliminated to meet the barrier-free opening force requirement through 90° of opening.
- Selectable delayed action between 175° and 70°.
- All other details are the same as the BTS75V.

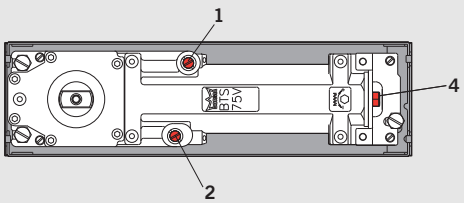
1 Valve adjustment 70°–0°.

2 Valve adjustment [a]175°–70°. Selectable delayed action from [b]175° to 75°.

3 Single point hold open units available at 90°.

4 Spring power adjustment.



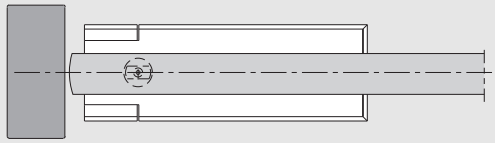


NOTE: If door hardware or adjacent structures interfere with maximum opening, an auxiliary stop is required.

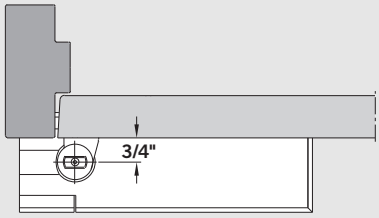
Applications

Accessory packages for the following applications are designated with an alpha suffix, i.e. “A,” “B.” For application details and accessory illustrations, see **BTS Applications and Accessories** brochure.

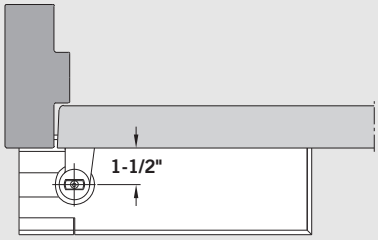
Center Hung Packages (A,B,G,H)



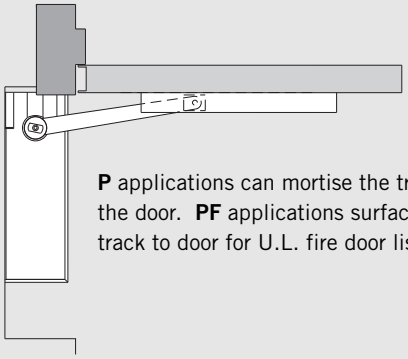
3/4" Offset Packages (D,E,F)



1-1/2" Offset Packages (C, C-E, C-F)

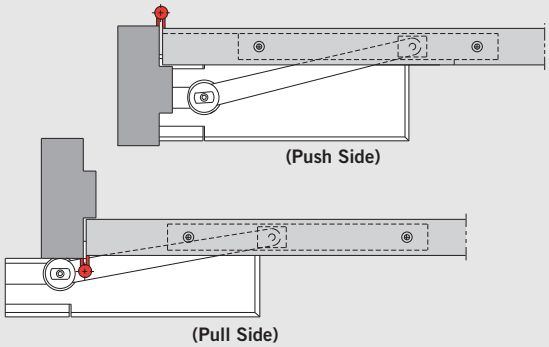


Pocket Door Packages (P)
Pocket Fire Door Packages (PF)

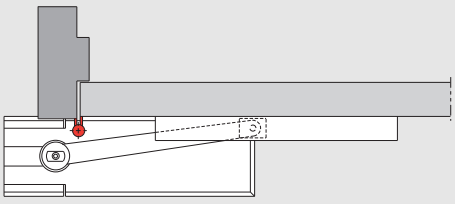


P applications can mortise the track in the door. **PF** applications surface apply track to door for U.L. fire door listing.

Independent Hung Packages (I)



Independent Hung Fire Door Packages (IF)



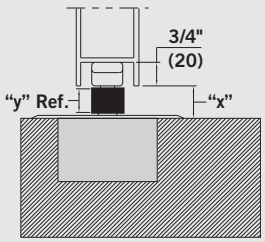
Track is surface applied to the door for U.L. fire door listing.

Spindles

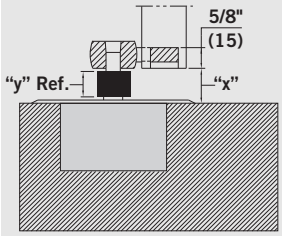
Spindle No.	Dimension "x" (Door Clearance)	3° Pre-load Spindle No.	Dimension "y"
74003	5/16"	80003	1/8"
74005	1/2"	80005	5/16"
74007	5/8"	-	7/16"
(STD)74010	3/4"	80010	1/2"
74012	13/16"	-	5/8"
74015	7/8"	80015	11/16"
74020	1-1/8"	80020	7/8"
74025	1-5/16"	80025	1"
74030	1-1/2"	80030	1-5/16"
74035	1-11/16"	-	1-1/2"
74040	1-7/8"	-	1-11/16"
74045	2-1/16"	-	1-7/8"
74050	2-5/16"	-	2-1/16"

Pre-load Spindles
Spindles are available with a 3° pre-load for additional pressure to hold door in the closed position. Normally, this is only necessary for center-pivoted single acting applications. However, they can also be used with other applications to compensate for templating errors. Specify hand of pre-load spindle when ordering.

Center Hung Applications



Offset Hung Applications



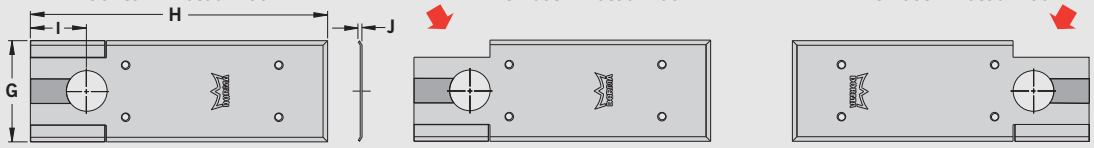
Extended Spindle Insert
NOTE: Closer and arm must be installed per template for door clearances shown to be valid.
Closers with extended spindle inserts are used with thresholds, carpeted floors, or terrazzo pans or in cases where more clearance between door and floor is required. All spindles are zinc plated.

Cover Plate

Universal cover plate **7510**, suitable for left hand/right hand, 3/4" offset, 1-1/2" offset and center pivoted doors. Material is stainless steel or brass depending on the plated finish specified.

	G	H	I	J
Inches	4-1/8	12-1/8	2-9/32	3/32
Millimeters	105	308	58	2

Center Pivoted Door **R.H. Offset Pivoted Door** **L.H. Offset Pivoted Door**



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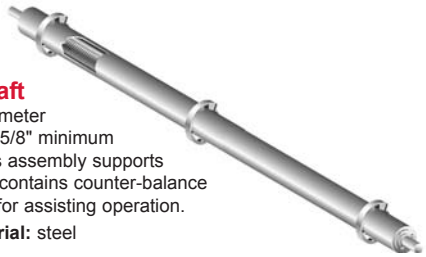
Counter Door Components

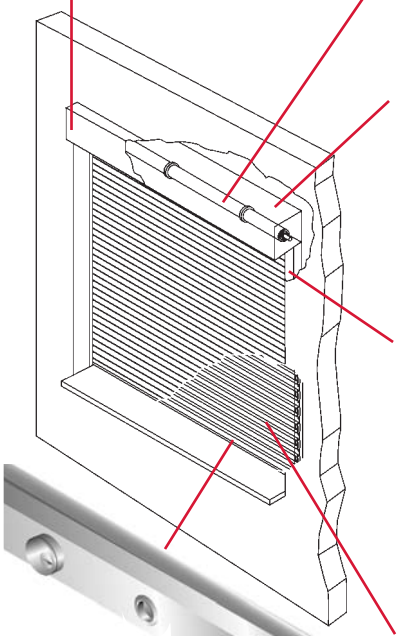
Brackets
Minimum 16 gauge steel plates that bolt to guide assembly and support the counter balance shaft and curtain.

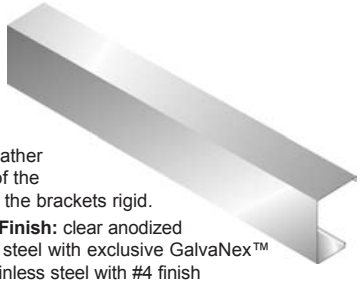
Standard Material & Finish: steel, with SpectraShield® powder coating 30-7192 gray



Counter-balance Shaft
3" minimum diameter outer shaft and 5/8" minimum inner shaft. This assembly supports the curtain and contains counter-balance torsion springs for assisting operation.

Standard Material: steel





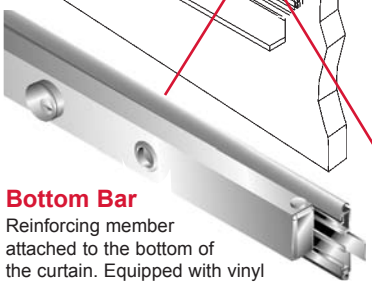
Hood
Protective sheet metal enclosure for the curtain that provides weather resistance at the head of the counter door and keeps the brackets rigid.

Standard Material and Finish: clear anodized aluminum or galvanized steel with exclusive GalvaNex™ finish in light gray or stainless steel with #4 finish

Guides
Side rail assemblies that bolt to the wall and support the entire weight of the counter door unit.

Standard Material & Finish: two piece clear anodized extruded aluminum sections with polypropylene pile runners

Optional Materials: stainless steel or galvanized steel



Bottom Bar
Reinforcing member attached to the bottom of the curtain. Equipped with vinyl astragal/weather-seal to cushion the contact point on the counter. Locking mechanisms available.

Standard Material & Finish: clear anodized extruded aluminum for aluminum and galvanized curtains or stainless steel #4 finish for stainless steel curtains.

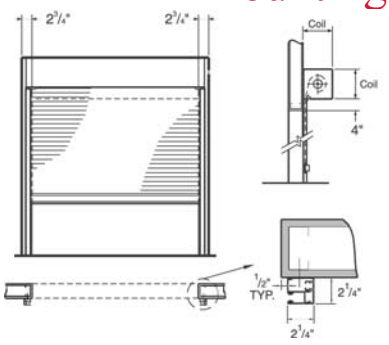
Optional Material: galvanized steel

Curtain
Interlocking roll formed flat-faced 1-1/2" high slats with endlocks riveted to ends of alternate slats to maintain curtain alignment and prevent wear.

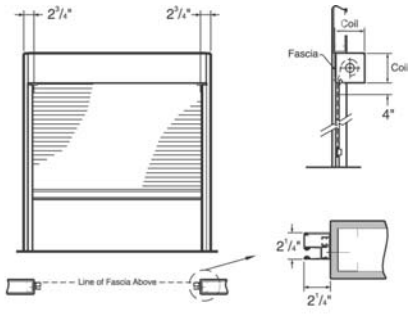
Standard Material & Finish: .040" thick clear anodized aluminum or 22 gauge galvanized steel with exclusive GalvaNex™ finish in light gray or 22 gauge stainless steel with #4 finish

Operation
Push-up operation shown. Hand crank and motors are available. Counter doors operate by rotating the shaft gear end. The opposite end of shaft applies spring tension and is equipped with a spring adjusting wheel.

Mounting & Clearances



Face of Wall
Maintains clearance of full opening, minimal exposed components.



Between Jambs
Mounts within the opening, fascia (front hood closure piece) required.

Counter doors are built to order to fit specific dimensions up to 21' wide, 10' high or a maximum of 120 square feet.

Special Applications

- Roll Top Enclosures - for applications that require units to fully or partially cover horizontal openings with the use of curved tracks. Curtains can either coil or store horizontally out of the opening.
- Fixed Guide Mullions - are provided to use multiple units side by side on wide openings using minimal track space.
- Removable Guide Mullions - used for wide openings that require full access on a limited basis.
- Corner Mullions - allow guides from two units to be mounted at 90° on a common tube utilizing an over/under coil set up.
- Machine Guards - ScreenGard™ or solid curtain counter door units may be mounted on machine frame assemblies to provide safety and easy access to machine components.
- Dual Height Countertop Units - special counter door designs can accommodate openings with two different counter heights.
- Countertops - 14 gauge stainless steel countertops are available up to 12' wide, 20" deep. Plastic laminate countertops are available up to 16' wide, 36" deep, in a range of standard laminates.

Optional Finishes

- Aluminum with medium, dark or black anodized finish
- Powder coat finish in selected color
- Zinc Rich Gray corrosion resistant powder coating
- Hot-dip galvanizing on steel components

SpectraShield® Powder Coat Finish

Cornell's SpectraShield® Powder Coat Finish adds durability and aesthetic value to our products in a choice of over 200 colors. Surface preparation and the coating process produces a smooth, long lasting finish at controlled costs.

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END OF SECTION 08 71 00

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Glazed entrances.
4. Interior borrowed lites.
5. Storefront framing.
6. Glass Flooring.

1.3 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

F. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
   a. Specified Design Wind Loads: As indicated, but not less than wind loads applicable to Project as required by ASCE 7 "Minimum Design Loads for Buildings and Other Structures" : Section 6.0 "Wind Loads."

   b. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch (25 mm), whichever is less.

      1) For monolithic-glass lites heat treated to resist wind loads.
      2) For insulating glass.
      3) For laminated-glass lites.

   c. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.

2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:

    a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F (W/sq. m x K).
    b. Solar Heat Gain Coefficient: NFRC 200.
    c. Solar Optical Properties: NFRC 300.

1.5 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: For the following products, in the form of 12-inch- (300-mm-) square Samples for glass and of 12-inch- (300-mm-) long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

C. Samples: For the following products, in the form of 12-inch- (300-mm-) square Samples for glass.

1. Each color of tinted float glass.
2. Coated vision glass.
3. Ceramic-coated spandrel glass.
4. Wired glass.
5. Insulating glass for each designation indicated.
6. For each color (except black) of exposed glazing sealant indicated.

D. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

E. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.

F. Qualification Data: For installers.

G. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

H. Product Test Reports: For each of the following types of glazing products:

1. Tinted float glass.
2. Coated float glass.
3. Insulating glass.
4. Glazing sealants.

5. Glazing gaskets.

I. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass laminated glass and insulating glass.

C. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control low-e coatings of a primary glass manufacturer that has established a certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.

D. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

E. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.

1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
2. Glass Testing Agency Qualifications: An independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

F. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.

1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.

G. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.

H. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

I. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:

1. Insulating Glass Certification Council.
2. Associated Laboratories, Inc.

K. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F (4.4 deg C).

1.9 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Five years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 GLASS PRODUCTS

A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.

1. Ultra-Clear (Low-Iron) Float Glass: Class I (clear); with a minimum 91 percent visible light transmission and a minimum solar heat gain coefficient of 0.87.

a. Available Products:

1) AFG Industries Inc.; Krystal Klear.

2) Pilkington Building Products North America; Optiwhite.
3) PPG Industries, Inc.; Starphire.

B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
3. For uncoated glass, comply with requirements for Condition A.
4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
5. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.

C. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B (spandrel glass, one surface ceramic coated), Type I (transparent flat glass), Quality-Q3, and complying with other requirements specified.

1. Fallout Resistance: Provide spandrel units identical to those passing the fallout-resistance test for spandrel glass specified in ASTM C 1048.

D. Pyrolytic-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide coating applied by pyrolytic deposition process during initial manufacture, and complying with other requirements specified.

E. Coated Spandrel Float Glass: Float glass complying with other requirements specified and with the following:

F. Wired Glass: ASTM C 1036, Type II (patterned and wired flat glass), Class 1 (clear), Quality-Q-6; and of form and mesh pattern specified.

G. Laminated Glass: ASTM C 1172, and complying with other requirements specified and with the following:

1. Interlayer: Polyvinyl butyral or cured resin of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.

a. For polyvinyl butyral interlayers, laminate lites in autoclave with heat plus pressure.
b. For cured-resin interlayers, laminate lites with laminated-glass manufacturer's standard cast-in-place and cured-transparent-resin interlayer.

2. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets.

H. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.

1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated or required by code.
3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
4. Sealing System: Dual seal, with primary and secondary sealants as follows:

    a. Manufacturer's standard sealants.

5. Spacer Specifications: Manufacturer's standard spacer material and construction.

6. Glass Filler: Low E II - Argon gas.

2.3 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:

1. Neoprene, ASTM C 864.
2. EPDM, ASTM C 864.
3. Silicone, ASTM C 1115.
4. Thermoplastic polyolefin rubber, ASTM C 1115.
5. Any material indicated above.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:

1. Neoprene.
2. EPDM.
3. Silicone.
4. Thermoplastic polyolefin rubber.
5. Any material indicated above.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.4 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Single-Component Neutral-Curing Silicone Glazing Sealants:

a. Available Products:

1) Dow Corning Corporation; 790.
2) GE Silicones; SilPruf LM SCS2700.
3) Tremco; Spectrem 1 (Basic).
4) GE Silicones; SilPruf SCS2000.
5) Pecora Corporation; 864.
6) Pecora Corporation; 890.
7) Polymeric Systems Inc.; PSI-641.
8) Sonneborn, Div. of ChemRex, Inc.; Omniseal.
9) Tremco; Spectrem 3.

b. Type and Grade: S (single component) and NS (nonsag).
c. Class: 50.
d. Use Related to Exposure: NT (nontraffic).

2.5 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.7 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.

C. Grind smooth and polish exposed glass edges and corners.

2.8 MONOLITHIC FLOAT-GLASS UNITS

A. Uncoated Clear Float-Glass Units: Class 1 (clear) annealed or Kind HS (heat-strengthened) float glass where heat strengthening is required to resist thermal stresses induced by differential shading of individual glass lites and to comply with system performance requirements.

1. Thickness: 6.0 mm.
2. Location: Interior barrowed lights unless noted otherwise.

2.9 MONOLITHIC CERAMIC-COATED SPANDREL-GLASS UNITS

A. Ceramic-Coated Spandrel-Glass Units:

1. Class 2 (tinted) float glass.

2. Kind FT (fully tempered).
3. Thickness: 6.0 mm.
4. Ceramic Coating Color: As selected by Architect from manufacturer's full range.
5. Coating Location: Second surface.

2.10 MONOLITHIC WIRED-GLASS UNITS

A. Polished Wired-Glass Units: Form 1 (wired glass, polished both sides), Quality-Q6, Mesh 2 (M2) (Square), 6.0 mm thick.

1. Available Manufacturers:

a. Asahi/AMA Glass Corp.; affiliated with AFG Industries, Inc.
b. Central Glass Co., Ltd.; distributed by Northwestern Industries Inc.
c. Pilkington Sales (North America) Ltd.

2.11 INSULATING-GLASS UNITS

A. Clear Insulating-Glass Units:

1. Overall Unit Thickness and Thickness of Each Lite: 25 and 6.0 mm.
2. Outdoor Lite: Class 1 (clear) float glass.
a. Annealed or Kind FT (fully tempered) where required by code.

3. Indoor Lite: Class 1 (clear) float glass.

a. Annealed Kind FT (fully tempered) where required by code.

B. Passive Solar Low-E Insulating-Glass Units:

1. Overall Unit Thickness and Thickness of Each Lite: 25 and 6.0 mm.
2. Outdoor Lite: Class 1 (clear) float glass.
a. Annealed or Kind FT (fully tempered) where required by code.

3. Indoor Lite: Class 1 (clear) float glass.

a. Annealed or Kind FT (fully tempered) where required by code.
4. Low-E Coating or Film: Pyrolytic or sputtered on second or third surface or low-e-coated film suspended in the interspace.
5. Silk-Screened Coating: Ceramic enamel on second surface.

C. Ceramic-Coated Spandrel Insulating-Glass Units:

1. Construction: Provide units that comply with requirements specified for insulating-glass units designated except for indoor lite.
2. Indoor Lite: Ceramic-coated spandrel glass.

    a. Kind FT (fully tempered).
    b. Ceramic Coating Location: Fourth surface.
    c. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm) as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.6 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.7 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 089000 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes fixed, formed-metal louvers.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide louvers capable of withstanding the effects of gravity loads and wind loads based on a uniform pressure of 30 lbf/sq. ft. (1436 Pa), acting inward or outward, without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors.

B. Seismic Performance: Provide louvers capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

C. Thermal Movements: Provide louvers that allow for thermal movements resulting from a temperature change (range) of 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces, by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

D. Air-Performance, Water-Penetration, and Wind-Driven Rain Ratings: As demonstrated by testing manufacturer's stock units according to AMCA 500-L.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.

1. Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings.
2. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples: For each type of finish.

D. Product test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Louvers:

a. Airline Products Co.
b. Airolite Company (The).
c. American Warming and Ventilating, Inc.
d. Arrow United Industries.
e. Carnes Company, Inc.
f. Cesco Products.
g. Construction Specialties, Inc.
h. Dowco Products Group; Safe-Air of Illinois, Inc.
i. Greenheck.
j. Industrial Louvers, Inc.
k. Louvers & Dampers, Inc.
l. Metal Form Manufacturing Company, Inc.
m. NCA Manufacturing, Inc.
n. Nystrom Building Products.
o. Reliable Products; Hart & Cooley, Inc.
p. Ruskin Company; Tomkins PLC.
q. Vent Products Company, Inc.

2.2 MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy 3003 or 5005.

C. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) zinc coating, mill phosphatized.

D. Stainless-Steel Sheet: ASTM A 666, Type 304, with No. 4 finish.

E. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

A. Fabricate frames to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

B. Join frame members to each other and to louver blades with fillet welds concealed from view.

C. Join frame members to each other and to louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer, concealed from view.

2.4 FIXED, FORMED-METAL LOUVERS

A. Horizontal, Drainable-Blade Louver:

1. Frame and Blade Material and Nominal Thickness: Galvanized steel sheet, not less than 0.052 inch (1.3 mm) for frames and 0.040 inch (1.0 mm) for blades.
2. Frame and Blade Material and Nominal Thickness: Stainless-steel sheet, but not less than 0.050 inch (1.3 mm).
3. Performance Requirements:

    a. Free Area: Not less than 7.0 sq. ft. (0.65 sq. m) for 48-inch- (1.2-m-) wide by 48-inch- (1.2-m-) high louver.
    b. Point of Beginning Water Penetration: Not less than 800 fpm (4.1 m/s).

2.5 LOUVER SCREENS

A. General: Provide screen at interior face of each exterior louver.

B. Louver Screen Frames: Same kind and form of metal as indicated for louver to which screens are attached.

C. Louver Screening:

1. Bird Screening: Aluminum, 1/2-inch- (12.7-mm-) square mesh, 0.063-inch (1.6-mm) wire.

2.6 FINISHES

A. Galvanized Steel, Powder-Coated Finish: Immediately after cleaning and pretreating, apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm).

1. Color and Gloss: As selected from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

E. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

END OF SECTION 089000

SECTION 092600

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
1. Interior gypsum wallboard.
2. Tile backing panels.
3. Gypsum board shaft wall assemblies.
4. Acoustical insulation and sealants.
5. Non-load-bearing steel framing.
6. Firestopping.
7. Dens Glass.

B. Related Sections include the following:
1. Division 7 Section "Fire-Resistive Joint Systems" for fire-resistive joints not covered by work of this Section.
2. Division 5 Section "Cold-Formed Metal Framing" for load-bearing steel framing and gypsum sheathing.
3. Division 7 Section "Joint Sealants" for sealants not covered by work of this Section.
4. Division 9 painting Sections for coordination/inspection requirements with painting contractor and primers applied to gypsum board surfaces.

1.03 DEFINITIONS

A. Gypsum Board Terminology: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.04 SUBMITTALS

A. General: Submit in accordance with Section 01330.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.

D. Firestopping: For each joint condition where fire-rated walls and partitions interface other walls, floors, structural members or other building structure, provide UL firestop system description and drawing. Show each kind of construction condition and relationships to adjoining construction. Indicate which firestop materials will be used where and thickness for

different hourly ratings. Include UL firestop design designation that evidences compliance with requirements for each condit

1.05 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory," GA-600, "Fire Resistance Design Manual," or in listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
   2. Deflection Firestop Track: Top runner indicated in fire-resistance-rated assemblies shall be labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.

B. Source Limitations for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single source from a single manufacturer.

C. Source Limitations for Panel Products: Obtain each type of gypsum board and other panel products from a single source from a single manufacturer.

D. Source Limitations for Finishing Materials: Obtain finishing materials from either manufacturer supplying gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

E. Gypsum Board Finish Mockups: Before finishing gypsum board assemblies, install mockup using room designated by Architect to demonstrate aesthetic effects and qualities of materials and execution.
   1. Install mockups for surfaces indicated to receive nontextured paint finishes.
   2. Simulate finished lighting conditions for review of mockups.
   3. Mockup will be painted under Division 9 Section "Painting" to provide finished condition for viewing.
   4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to on leveled supports off floor or slab prevent sagging.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

D. Room Temperatures: For nonadhesive attachment of gypsum board to framing, maintain not less than 40 deg F. For adhesive attachment and finishing of gypsum board, maintain not less than 50 deg F for 48 hours before application and continuously after until dry. Do not exceed 95 deg F when using temporary heat sources.

E. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
   2. Products: Subject to compliance with requirements, provide one of the products specified.

2.02 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

A. Components, General: Comply with ASTM C 754 for conditions indicated.
   1. Manufacturers:
      a. Dale Industries, Inc. - Dale/Incor.
      b. Dietrich Industries, Inc.
      c. MarinoWare; Division of Ware Industries.
      d. National Gypsum Company.
      e. Unimast, Inc.

B. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, not less than 0.1620-inch- diameter (8-gage) wire, or double strand of not less than 0.099-inch- diameter (12-gage) wire.

C. Hanger Attachments to Concrete: As follows:
   1. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.

D. Hangers: As follows:
   1. Wire Hangers: ASTM A 641, Class 1 zinc coating, soft temper, 0.162-inch (8-gage) diameter.

E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch, a minimum 1/2-inch- wide flange, with ASTM A 653, G40, hot-dip galvanized zinc coating.
   1. Depth: As indicated.

F. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653, G40, hot-dip galvanized zinc coating.
   1. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
      a. Minimum Base Metal Thickness: 0.0312 inch (22 gage).

G. Grid Suspension System for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock, heavy-duty.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Armstrong World Industries, Inc.; Furring Systems/Drywall.
      b. Chicago Metallic Corporation; Drywall Furring 640 System.
      c. USG Interiors, Inc.; Drywall Suspension System.
      d. Provide comparable system where fire-rated ceilings are indicated.

2.03 STEEL PARTITION AND SOFFIT FRAMING

A. Manufacturers:
   1. Dale Industries, Inc. - Dale/Incor.
   2. Dietrich Industries, Inc.
   3. MarinoWare; Division of Ware Industries.
   4. National Gypsum Company.
   5. Unimast, Inc.

B. Components, General: As follows:
   1. Comply with ASTM C 754 for conditions indicated.
   2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653, G40, hot-dip galvanized zinc coating.

C. Steel Studs and Runners: ASTM C 645.
   1. Minimum Base Metal Thickness: 0.027 inch (22gage)minimum, unless otherwise indicated.
      a. Provide studs with 0.0329 inch (20-gage) minimum thickness at the following locations:
         1) For 6 inch or greater framing.
         2) Jamb studs for door openings.
         3) At locations to receive abuse-resistant board.
         4) Where indicated.
      b. Provide studs with recognizable identifier on surface so different gages installed in walls can be easily identified.
   2. Depth: As indicated.
   3. Maximum Allowable Deflection: Increase metal thickness where required to meet the following:
      a. Maximum Allowable Deflection for Drywall Assemblies: L/240 calculated using a 5 pound per square uniform load perpendicular to studs and based on stud properties alone.
      b. Maximum Allowable Deflection for Drywall Assemblies Receiving Tile: L/360 calculated using a 5 pound per square uniform load perpendicular to studs and based on stud properties alone.

D. Deep-Leg Deflection Track: ASTM C 645 top runner with flanges to allow for 3/4-inch deflection at floors and 1-1/2 inch at roofs.

E. Firestop Deflection Track: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs. Provide deflection track with flanges to allow for 3/4-inch deflection at floors and 1-1/2 inch at roofs.
1. Product: Subject to compliance with requirements, provide the following:
   a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base Metal Thickness: 0.0598 inch (16-gage), unless indicated otherwise.

G. Cold-Rolled Channel Bridging: 0.0538-inch (16-gage) minimum bare steel thickness, with minimum 1/2-inch- wide flange.
1. Depth: 1-1/2 inches.
2. Clip Angle: 1-1/2 by 1-1/2 inch, 0.068-inch- thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base Metal Thickness: 0.0312 inch (20 gage).
2. Depth: 7/8 inch, unless otherwise indicated.

I. Furring Brackets: Serrated-arm type, adjustable, fabricated from corrosion-resistant steel sheet complying with ASTM C 645, 20 gauge, .0329 inch, designed for screw attachment to steel studs and steel rigid furring channels used for furring.

J. Deflection Brackets:
1. Construction: Slotted galvanized steel angle with step bushing to prevent over tightening of fasteners.
2. Vertical Deflection: 1-1/2 inch total travel.
3. Product: VertiClip; Signature Industries, (919) 844-0789.
   a. Series: SL, SDL, SLB, and SLS as required by attachment condition.

K. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members to substrates involved; complying with recommendations of gypsum board manufacturers for applications indicated.

2.04 INTERIOR GYPSUM WALLBOARD

A. Manufacturers:
1. G-P Gypsum Corporation.
2. National Gypsum Company.
3. United States Gypsum Company.

B. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

C. Gypsum Wallboard (GPDW & GWB): ASTM C 36.
1. Type X:
   a. Thickness: 5/8 inch.

b. Long Edges: Tapered.
c. Location: All locations, except as otherwise noted.

D. Impact- and Penetration-Resistant Gypsum Wallboard: ASTM C 630 and C 1396, Type X; gypsum core wall panel with additives to enhance fire- and mold/mildew-resistance of core; surfaced with abrasion-, moisture-, and mold/mildew-resistant paper on the front, back and long edges; with a fiberglass mesh embedded in the board to enhance impact/penetration resistance.
1. Products:
a. Hi-Impact Brand XP Fire-Shield Wallboard; National Gypsum Company.
b. Fiberock Brand VHI Abuse-Resistant Gypsum Fiber Interior Panels; United States Gypsum Co.
2. Thickness: 5/8 inch.
3. Long Edges: Tapered.
4. Surface Abrasion Resistance: ASTM D 4977 (Modified), not greater than 0.284 inch depth when tested at 50 cycles.
5. Indentation Resistance: ASTM D 5420, not greater than 0.16 inch depth when tested at an impact load of 72 in.-lbs.
6. Impact/Penetration Resistance: ASTM E 695, not less than 480 ft.-lbs required to penetrate when using a weight of 60 lbs.
7. Mold/Mildew Resistance: ASTM D 3273, not less than 8.
8. Location: Where indicated.

2.05 EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Exterior Gypsum Soffit Board: ASTM C 931, with manufacturer's standard edges.
1. Core: Manufacturers standard.

2.06 GYPSUM BOARD SHAFT-WALL ASSEMBLIES

A. General: Provide assemblies constructed of proprietary gypsum liner panels inserted between steel tracks at each end of studs; with specially shaped steel studs engaged in tracks and fitted between gypsum liner panels; and with gypsum board on finished side or sides applied to studs in the number of layers, thicknesses and arrangement indicated.

B. Partition Framing: ASTM C 645, manufacturer’s standard stud profile, hot-dip galvanzied, for repetitive members and corner and end members and for fire-resistance-rated assembly indicated.
1. Depth: As indicated.
2. Track (Runner): Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches, in depth matching studs.
3. Minimum Base Metal Thickness: Manufacturer's standard thicknesses that comply with structural performance requirements for stud depth indicated, but not less than 0.0359 inch (20 gage).
4. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft-wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
a. Powder-Actuated Fasteners: Provide powder-actuated fasteners with capability to sustain, without failure, a load equal to 10 times that imposed by shaft-wall

assemblies, as determined by testing conducted by a qualified independent testing agency according to ASTM E 1190.

C. Gypsum Liner Panels: Manufacturer's proprietary liner panels in 1-inch thickness and with moisture-resistant paper faces.

D. Cavity Insulation: Provide sound-attenuation blankets in cavity formed by studs between shaft-wall liner panels and room-side finish.

E. Finishes:
1. Room-Side: As indicated.
2. Shaft Side: Provide only where finish is indicated on shaft side as well as room side, otherwise leave liner panel exposed.

2.07 DENS-GLASS SHEATHING

A. Dens glass is a composite of water resistant, treated gypsum core which is non-combustible and dimensional stable. The core is an R integral part of glass mat facing on both sides.

1. Thickness: 1/2" unless noted otherwise.

2. Edges: Square

3. Manufacturer: G-P Gypsum Corporation or approved equal.

2.08 STRUCTURAL PANEL FLOOR/CEILING SYSTEM

A. Floor framing-cold formed steel with minimum G-60 galvanized coating, minimum 18 gauge meeting AISI and ASTM specifications and requirements for use in a structural floor system.

B. Floor Sheating - 3/4" FORTACRETE Structural Panels manufactured by United States Gypsum Company or architectural approved equal.

C. Fasteners:

1. Screws-self drilling tapping screws meeting the SAE standard J78. 1013-1022 steel wire, 8-18 x 1-5/8" with minimum 0.250" bugle head design.

2. Screws must be capable of bending 15 degrees without sign of fracture, have a torsion strength of 42 inch-lbs per SAE J81, meet SAE J78 for hardness.

3. Screws must have a corrosion resistance that sustains 250 hours of ASTM B117 salt spray test prior to development of white corrosion products.

4. Location: Raised floor at Lecture Hall.

2.09 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047, galvanized steel.
1. Shapes:
a. Cornerbead: 1-1/4 inch x 1-1/4 inch external corner with 1/8-inch nose bead. Use at outside corners, unless otherwise indicated.

b. LC-Bead (Casing): J-shaped casing with 1/16-inch nose bead ground, not less than 30 gage; exposed long flange receives joint compound; use at exposed panel edges.
c. L-Bead: L-shaped; exposed long leg receives joint compound; use where indicated.
d. U-Bead: J-shaped; exposed short flange does not receive joint compound; use at exposed panel edges and where indicated.
e. Expansion (Control) Joint: One-piece control joint formed with V-shaped slot and removable strip covering slot opening.

B. Exterior Trim: ASTM C 1047.
1. Material: Hot-dip galvanized steel sheet.
2. Shapes:
a. Cornerbead: Use at outside corners.
b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening. Use where indicated.

C. Interior “Z” Reveal Molding:
1. Material: Extruded Aluminum
2. Description:
a. “Z” Reveal Molding Manufactured by Fry Reglet Corporation.
b. Reveal molding shall form a trim reveal around doors or between walls and floors

2.10 ACOUSTICAL SEALANT

A. Products:
1. Acoustical Sealant for Exposed and Concealed Joints:
a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
2. Acoustical Sealant for Concealed Joints:
a. Ohio Sealants, Inc.; Pro-Series SC-175 Acoustical Sound Sealant.
b. Pecora Corp.; AIS-919.
c. Tremco, Inc.; Tremco Acoustical Sealant.

B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

C. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

2.11 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Fastening gypsum board to steel members: Type S bugle head.

C. Sound Attenuation Blankets (Acoustical Insulation): ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
   1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
   2. Manufacturers:
      a. Certainteed.
      b. Owens Corning.
      c. Johns Manville.

D. Insulation Support Anchors: Insul-Fast 25 gauge galvanized continuous metal support strip with pre-punched tabs at 8 inches on center.

E. Polyethylene Vapor Retarder: As specified in Division 7 Section "Building Insulation."

F. Firestopping: See Division 7 Section "Through-Penetration Firestop Systems." Provide firestopping where fire rated gypsum board assemblies butt masonry, steel deck, joists, beams, and structural members as part of the gypsum board assembly work. Penetrations through fire-resistance-rated walls and partitions by Division 15 and 16 work, including both empty openings and openings containing cables, pipes, ducts and conduits are specified as part of the Division 15 and 16 work.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Post-Installation Inspection: Inspect walls for dents and imperfections, with Installer and painter present, prior to painting. Inspect wall again after primer and first coat of paint applied, with Installer and painter present. Installer shall touch-up as follows:
   1. Touch-up visible gypsum board imperfections before priming of walls.
   2. Touch-up imperfections found in field of boards and joints made visible from painting after first finish coat applied.
   3. Joint compound touch-up shall be primed and pained before final coat is applied and viewed for acceptability.

3.02 PREPARATION

A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building

structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.

3.03 INSTALLING STEEL FRAMING, GENERAL

A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement. Comply with details shown on Drawings.
   1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
   2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
      a. Allow for 3/4-inch deflection at floors and 1-1/2 inches at roofs.
      b. Install deflection track top runner or deflection brackets to attain lateral support and avoid axial loading.
      c. Install deflection firestop track top runner at fire-resistance-rated assemblies.
         1) Attach jamb studs at openings to tracks using manufacturer's standard stud clip.

D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.04 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

A. Suspend ceiling hangers from building structure as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
   3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
   4. Do not attach hangers to steel roof deck. Attach hangers to structural members.
   5. Do not connect or suspend steel framing from ducts, pipes, or conduit.

B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.

C. Sway-brace suspended steel framing with hangers used for support.

D. For exterior soffits, install cross bracing and framing to resist wind uplift.

E. Wire-tie furring channels to supports, as required to comply with requirements for assemblies indicated.

F. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.
1. Hangers: 48 inches o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 16 inches o.c.

G. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
1. Fire-Rated Ceilings:
   a. Butt Joints: Provide extra cross tees spaced 8 inches or less on either side of butt joints.
   b. Fire Relief Notch: Provide a hanger wire installed adjacent to fire relief notch.

3.05 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.

B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
1. Cut studs 1/2 inch short of full height to provide perimeter relief. Do not fasten studs to top track to allow independent movement of studs and track.
2. For fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.

D. Install steel studs and furring at the following spacings:
1. Single-Layer Construction: 16 inches o.c., unless otherwise indicated.
2. Multilayer Construction: 16 inches o.c., unless otherwise indicated.

E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.

1. Attach both flanges to floor runner track with screws.

F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
1. Install two studs at each jamb, unless otherwise indicated.
2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint.
3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above, even when partitions are not full height. Provide diagonal bracing at tall partitions to stop deflection and vibration of studs when doors are slammed shut.
4. Extend jamb studs one-piece full height.

G. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

H. Frame chase walls and double stud party walls to indicated widths. Provide 2-1/2 inch steel stud cross bracing, spaced maximum 48 inches on center.

3.06 INSTALLATION OF ACOUSTICAL INSULATION

A. Install acoustical insulation at locations indicated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections that interfere with placement.

B. Install a single layer of insulation of required thickness to fill the full depth of cavity, unless otherwise shown. Where cavity requires insulation that is thicker than standard size, install next larger size and compress into cavity.

C. Hold batt insulation in place with insulation support anchors located at 5 feet on center, full height of wall, starting at the top of each stud space.

D. Stuff glass fiber loose fill insulation into miscellaneous voids and cavity spaces. Fill box headers, and voids while framing is being erected that will be inaccessible for installation later. Compact to approximately 40 percent of normal maximum volume (to a density of approximately 2.5 pcf).

3.07 INSTALLATION OF GYPSUM BOARD SHAFT-WALL ASSEMBLIES

A. General: Install gypsum board shaft-wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 for installing steel framing.

B. Do not bridge building expansion joints with shaft-wall assemblies; frame both sides of joints with furring and other support.

C. Install supplementary framing in gypsum board shaft-wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft-wall assembly framing.

D. At penetrations in shaft wall, maintain fire-resistance rating of shaft-wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators and similar items.
   1. See Division 7 Section "Through-Penetration Firestop Systems" for treatment of space around perimeter of penetration.

E. Isolate gypsum finish panels from building structure to prevent cracking of finish panels while maintaining continuity of fire-rated construction.

F. Install control joints to maintain fire-resistance rating of assemblies.

G. Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with manufacturer's written instructions or ASTM C 919, whichever is more stringent.

3.08 APPLYING AND FINISHING PANELS, GENERAL

A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216, except as specified otherwise.

B. Install acoustical insulation, where indicated, before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

G. Attach gypsum panels to framing provided at openings and cutouts.

H. Form control and expansion joints with space between edges of adjoining gypsum panels.
   1. Where control joints are not shown, provide control joints at a maximum spacing of 30 feet; review proposed locations with Architect prior to installation.

I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.

2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- wide joints to install sealant. Caulk smoke partitions to prevent the passage of smoke.

J. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with casing bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

K. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
1. Space screws a maximum of 12 inches o.c. for vertical applications.

L. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

M. Remove screws that do not hit studs, supports, or blocking.

3.09 PANEL APPLICATION METHODS

A. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
a. Stagger abutting end joints not less than one framing member in alternate courses of board.

B. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

C. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

D. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.

E. Exterior Soffits and Ceilings: Apply exterior gypsum soffit board panels perpendicular to supports, with end joints staggered and located over supports.
1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

F. Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install at showers, and where indicated. Install with 1/4-inch gap where panels abut other construction or penetrations.

3.10 INSTALLING DENS GLASS

A. Install per Manufacturers Recommendations.

3.11 INSTALLING STRUCTURAL PANEL FLOOR SYSTEM

A. Install per Manufacturers Recommendations.

3.12 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Install corner bead at external corners.

C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.
1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
2. Install L-bead where edge trim can only be installed after gypsum panels are installed.
3. Install U-bead where indicated.

D. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

3.13 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, flanges of corner bead, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas using setting-type joint compound.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Apply joint tape over gypsum board joints and to flanges of trim accessories as recommended by trim accessory manufacturer.

E. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
1. Level 1: At ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
2. Level 2: Where panels are substrate for tile and where indicated.
3. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.

F. Glass-Mat, Water-Resistant Tile Backing Panels: Finish board forming base for ceramic tile to comply with ASTM C 840 and according to manufacturer's written instructions for treatment of joints behind tile.

G. Where Level 1 gypsum board finish is indicated, embed tape in joint compound. Surface shall be free of excess joint compound.

H. Where Level 2 gypsum board finish is indicated, fill fastener heads, embed tape in joint compound and apply thin coat of joint compound over all joints and interior angles.

I. For Level 4 gypsum board finish, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration.
   1. At tapered edge joints, draw compound down to a level plane, leaving a monolithic surface that is flush with the paper face. Finish coat shall be feathered a minimum of 8 inches beyond both sides of center of joint tape.
   2. At end-to-end butt joints, draw compound down to minimize hump created by joint tape application. Finish coat shall be feathered a minimum of 16 inches beyond both sides of center of joint tape.
   3. End product shall be a surface that appears level without telegraphing joint locations as high spots when viewed down wall after painting.
   4. Finish board to within 1/4 inch of floor, providing full support for resilient wall base without telegraphing joint.

3.14 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
   1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
   2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
      a. Installation of 80 percent of lighting fixtures, powered for operation.
      b. Installation, insulation, and leak and pressure testing of water piping systems.
      c. Installation of air-duct systems.
      d. Installation of air devices.
      e. Installation of mechanical system control-air tubing.
      f. Installation of above ceiling automatic fire suppression piping, including leak and pressure testing.
      g. Installation of ceiling support framing.

3.15 CLEANING AND PROTECTION

A. Promptly remove any residual joint compound from adjacent surfaces.

B. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensures gypsum board assemblies are without damage or deterioration at time of Substantial Completion.

END OF SECTION 09260

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Ceramic mosaic tile.
2. Wall tile.
3. Waterproof membrane for tile installations.
4. Metal edge strips installed as part of tile installations.

B. Related Sections include the following:
1. Division 03 Section "Cast-in-Place Concrete" for monolithic slab finishes specified for tile substrates.
2. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
3. Division 09 Section "Gypsum Board" for cementitious backer units.

1.3 DEFINITIONS

A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

B. Facial Dimension: Actual tile size (minor facial dimension as measured per ASTM C 499).

C. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.6.
2. Step Treads: Minimum 0.6.
3. Ramp Surfaces: Minimum 0.8.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

D. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Assembled samples with grouted joints for each type and composition of tile and for each color and finish required, at least 12 inches (300 mm) square and mounted on rigid panel. Use grout of type and in color or colors approved for completed work.
3. Full-size units of each type of trim and accessory for each color and finish required.
4. Metal edge strips in 6-inch (150-mm) lengths.

E. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

F. Product Certificates: For each type of product, signed by product manufacturer.

G. Qualification Data: For Installer.

H. Material Test Reports: For each tile-setting and -grouting product.

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain all tile of same type from one source or producer.

1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
1. Waterproofing.
2. Joint sealants.
3. Metal edge strips.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store liquid latexes and emulsion adhesives in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Turn over any open boxes to owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
3. Basis-of-Design Product: The design for each tile type is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.

C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

1. As selected by Architect from manufacturer's full range.

D. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 TILE PRODUCTS

A. Available Product:
1. Daltile: City View.
2. Approved architectural equal.

B. Unglazed Floor Quarry Tile: Square-edged flat tile as follows:

1. Wearing Surface: UPS.
2. Facial Dimensions: 24 by 24 inches
3. Face: Plain.
4. For furan-grouted quarry tile, precoat with temporary protective coating.
   a. Basis-of-Design Product: Crossville Bluestone; color: "Vermont Black".
5. Breaking strength: greater than 450 lbf
6. Bond strength: greater than 200 psi
7. Water absorption: Less than 0.20%
8. Static Coefficient of friction:
   a. Dry: Greater than 0.8
   b. Wet: Greater than 0.6

2.4 SETTING AND GROUTING MATERIALS

A. Available Manufacturers:

1. Atlas Minerals & Chemicals, Inc.
2. Boiardi Products Corporation.
3. Bonsal, W. R., Company.
4. Bostik.
5. C-Cure.
6. Custom Building Products.
7. DAP, Inc.
8. Jamo Inc.
9. LATICRETE International Inc.
10. MAPEI Corporation.
11. Southern Grouts & Mortars, Inc.
12. Summitville Tiles, Inc.
13. TEC Specialty Products Inc.

B. Dry-Set Portland Cement Mortar (Thin Set): ANSI A118.1.

1. For wall applications, provide nonsagging mortar that complies with Paragraph C-4.6.1 in addition to the other requirements in ANSI A118.1.

C. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:
1. Prepackaged dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive.

a. For wall applications, provide nonsagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.

D. Chemical-Resistant, Water-Cleanable, Tile-Setting and -Grouting Epoxy: ANSI A118.3**,** with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F (60 deg C) and 212 deg F (100 deg C), respectively, and certified by manufacturer for intended use.

2. Ceramic tile adhesive shall have a VOC level of no more than 65 g/L.

E. Standard Sanded Cement Grout: ANSI A118.6, color as indicated.

2.5 ELASTOMERIC SEALANTS

A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 07 Section "Joint Sealants."

1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

1. Available Products:

a. Dow Corning Corporation; Dow Corning 786.
b. GE Silicones; Sanitary 1700.
c. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
d. Tremco, Inc.; Tremsil 600 White.

2.6 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications, nickel silver or stainless steel; ASTM A 666, 300 Series exposed-edge material.

C. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTM D 87.
2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

E. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints that does not change color or appearance of grout.

2.7 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Provide concrete substrates for tile floors installed with adhesives or thin-set mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.

1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.

C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.

F. Lay out tile wainscots to next full tile beyond dimensions indicated.

G. Grout tile to comply with requirements of the following tile installation standards:

1. For ceramic tile grouts (sand-portland cement; dry-set, commercial portland cement; and latex-portland cement grouts), comply with ANSI A108.10.

3.4 FLOOR TILE INSTALLATION

A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.

B. Joint Widths: Install tile on floors with the following joint widths:

1. Ceramic Mosaic Tile: 1/16 inch (1.6 mm).

C. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

D. Grout Sealer: Apply grout sealer to **cementitious** grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on tile faces by wiping with soft cloth.

3.5 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove epoxy and latex-portland cement grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 093000

SECTION 093000 – TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:

1. Porcelain tile for floors.
2. Ceramic tile for walls.
3. Wall base, trim, and other accessories.
4. Stair Tile Nosings

B. Refer to Division 09 Section “Carpeting” for metal transition strips.

1.3 DEFINITIONS

A. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with minimum 0.6 value as determined by testing identical products per ASTM C 1028:

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples:

1. Assembled samples with grouted joints for each type and composition of tile and for each color and finish required, at least 12 inches square and mounted on rigid panel. Use grout of type and in color or colors approved for completed work.
2. Full-size units of each type of trim and accessory for each color and finish required.
3. Metal edge strips in 6-inch lengths.

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.

1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar and grout component from a single manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for specified metal trim.

D. Pre-installation Conference: Conduct conference at Project site to review issues that may affect the Work of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.

B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

C. Store liquid latexes in unopened containers and protected from freezing.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. PCT1: Porcelain ceramic tile for floors; 12”x24” with matching base; Design Basis – Dal Tile City View.

B. PCT2: Ceramic tile for walls in toilet rooms; 3”x6” with matching bullnose trims; Design Basis – Dal Tile Rittenhouse Square, color to be determined, matte finish.

2.2 SETTING AND GROUTING MATERIALS

A. Dry-Set Portland Cement Mortar (Thin Set): ANSI A118.1. For wall applications, provide nonsagging mortar that complies with Paragraph C-4.6.1 in addition to the other requirements in ANSI A118.1.

B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of prepackaged dry-mortar mix combined with acrylic resin liquid-latex additive. For wall applications, provide nonsagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.

C. Grout: Mold- and Mildew-resistant Grout (where scheduled): Design Basis Product: Mildew-resistant sanded grout with antimicrobial; Laticrete SpectraLock Pro Grout; color as selected by the Architect.

2.3 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.4 FINISHING AND EDGE-PROTECTION PROFILES FOR STAIR NOSINGS

A. Schluter®-TREP-E
   1. Description: roll-formed stainless steel (type 304 = V2A) profile with ribbed, 1-3/16 inch (30 mm) wide exposed surface with rounded leading edge, and integrated trapezoid-perforated anchoring leg.
   2. Material and Finish:
      [E - Stainless Steel Type 304 = V2A]

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

   1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.

2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in tile installation schedules.

B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in tile installation schedules.

C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

F. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles. Locate joints in tile surfaces directly above joints in concrete substrates.

G. Grout tile to comply with requirements of ANSI A108.10.

3.4 FLOOR TILE INSTALLATION

A. Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.

B. Joint Widths: Install tile on floors with 3/16 inch joint width, unless otherwise indicated.

C. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other dissimilar flooring that finishes flush with top of tile.

3.5 WALL TILE INSTALLATION

A. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

B. Joint Widths: Install tile on walls with 3/16 inch joint width, unless otherwise indicated.

3.6 CLEANING AND PROTECTION

A. Cleaning: On completion of placement and grouting, clean all tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.7 FLOOR TILE INSTALLATION SCHEDULE

A. Thin-set mortar setting method.

1. Mortar: Dry-set or Latex- portland cement mortar bond coat.
2. Grout: Mildew-resistant sanded grout with antimicrobial; Laticrete SpectraLock Pro Grout.
3. Joint Width: 3/16”.

3.8 WALL TILE INSTALLATION SCHEDULE

A. Thin-set mortar over cementitious backing board.

1. Mortar: Dry-set or Latex- portland cement mortar.
2. Grout: Mildew-resistant unsanded grout with antimicrobial; Laticrete SpectraLock Pro Grout.
3. Joint Width: 3/16".

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes acoustical panel ceilings and accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch- square Samples of each type, color, pattern, and texture.
2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- long Samples of each type, finish, and color.

C. Maintenance Data: For finishes to include in the Owner’s maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
2. Suspension System: Obtain each type through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

    a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
    b. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:

   a. Smoke-Developed Index: 450 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other deleterious causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANEL CEILINGS AND ACCESSORIES

A. Design Basis Product (ACT-1): Armstrong Cortega, medium textured, non-directional, fissured pattern.

1. NRC: Not less than 0.55.
2. CAC: 33.
3. Light Reflectance: 0.82.
4. Size: 24 by 24 by 5/8 inches thick.
5. Edge: Angled tegular.
6. Fire Rating: Class A.
7. Suspension System: 15/16 inch exposed tee.

B. Design Basis Product (ACT-2): Armstrong Health Zone Ultima, as follows:

1. Size: 24 by 24 inches by 3/4-inch thick.
2. Edge Profile: Beveled tegular.
3. NRC: 0.70.
4. CAC: 35.
5. LR: 0.86.
6. Fire Rating: Class A.
7. Grid: 15/16” co-extruded clean room grid.
8. Finish: Factory-applied latex paint with DuraBrite acoustically-transparent membrane.

C. Wide-Face, Capped, Double-Web, Steel Suspension System, fire-rated as required: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with prefinished 15/16-inch-wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Steel cold-rolled sheet.
5. Cap Finish: Painted white to match color of acoustical unit, unless otherwise indicated.

D. Special Perimeter Trim (Design Basis Product): Armstrong Axiom-Classic Perimeter Trim, 6063 extruded aluminum trim channel trim (8”) and bottom one-piece drywall trim, in profiles as indicated on the Drawings; factory-applied baked polyester paint finish in custom color as selected by the Architect; aluminum T-bar connection clips and hanging clips; galvanized steel splice plates; accessories include outside and inside corners and corner posts, and fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION, GENERAL

A. Install acoustical panel ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
6. Do not attach hangers to steel deck tabs.
7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
8. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
4. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

A. A.Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 – RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes resilient wall base.

B. Refer to Division 09 Section “Carpeting” for floor transition strips, resilient and metal.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide resilient accessories with a critical radiant flux classification of Class I, not less than 0.45 W/sq. cm, as determined by testing identical products per ASTM E 648 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After post-installation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 RESILIENT WALL BASE AND ACCESSORIES

A. Resilient Base: Design Basis manufacturer shall be Armstrong.

1. Material Requirement: ASTM F 1861, Type TP, Group 1 (solid).
2. Style: Straight (toeless) for carpeted floors and coved (toe) profile for hard floors.
3. Minimum Thickness: 0.125 inches.
4. Height: 4 inches.
5. Outside and Inside Corners: Preformed.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

3.3 RESILIENT WALL BASE INSTALLATION

A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. Do not stretch wall base during installation.

E. On irregular substrates (if any), fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

F. Premolded Corners: Install premolded corners before installing straight pieces.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil. Do not wash surfaces until after time period recommended by manufacturer.

B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION 096513

SECTION 096516 – RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 09 Section "Resilient Base and Accessories" for resilient wall base.

1.2 SUMMARY

A. This Section includes:

1. Heterogeneous sheet vinyl flooring.
2. Homogeneous sheet vinyl flooring.
3. Linoleum sheet flooring.

B. Refer to Division 09 Section “Carpeting” for resilient floor transition strips.

C. The Moisture Control System (MCS) as specified herein shall be provided unless the independent testing agency, based on testing results for alkalinity, moisture, and adhesive bonding, determines that the MCS is not required.

1. The Contractor shall determine a unit price for installing the MCS. If the MCS is not required or the Owner elects to waive the MCS installation, the Contractor shall furnish the Owner with a credit that relates to the applicable square feet of flooring.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated including adhesives and moisture control system to be used with each type of flooring specified herein. Product data shall indicate applicable compressive strength for floor underlayment.

B. Samples: In manufacturer's standard size, but not less than 6 x 9 inch Insert size sections of each different color and pattern of floor covering required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

C. Heat-welded Seam Samples: For each flooring product and welding bead color and pattern combination required; with seam running lengthwise and in center of 6 x 9 inch Sample applied to a rigid backing and prepared by Installer for this Project.

D. Maintenance Data: For floor coverings to include in the Owner’s maintenance manuals.

E. Diagrams in the form of CAD drawings showing all seaming patterns, grain directions, and other details including floor transition and pattern layout, for the Architect's review.

F. Mockups: Provide in-situ mockups of each flooring type specified herein. Mockups shall establish the acceptable level of workmanship expected in the finished Work. Provide a mockup of flash-coved integral base and cap, and both internal and external corners for review and approval by the Architect.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Qualified installers who employ workers for this Project that are competent in heat-welding techniques required by manufacturer for the respective floor covering installation.

1. Engage an installer who employs workers for this Project that are trained or certified by floor covering manufacturer for heat-welding techniques required.

B. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

C. Work of this Section shall be in accordance with applicable provisions of the Americans with Disabilities Act Accessibility Guidelines (ADA-AG).

D. Pre-installation Conference: Conduct a pre-installation conference at the Project site to review coordination issues related to the Work of this Section.

1. Meet with Owner, Architect, testing and inspecting agency representative, each flooring Installer, each flooring system manufacturer's representative, and installers of related work that interfaces with or affects the flooring installations specified herein.
2. Review methods and procedures related to each type of flooring installation, including the respective manufacturer's written instructions.
3. Obtain written approval of concrete substrate condition from the manufacturer's representative prior to commencing installation of moisture control system.
4. Obtain written approval of floor substrate condition from flooring manufacture prior to commencing flooring material installation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 degrees For more than 90 degrees F. Store rolls upright.

1.6 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 degrees F or more than 95 degrees F, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After post-installation period, maintain temperatures within range recommended by manufacturer, but not less than 55 degrees F or more than 95 degrees F.

C. Close spaces to traffic during floor covering installation.

D. Close spaces to traffic for 48 hours after floor covering installation.

E. Install floor coverings after other finishing operations, including painting, have been completed.

1.7 WARRANTY

A. Sheet Flooring: Submit the manufacturer's standard warranty form for ten (10) years from the date of Substantial Completion stating that the flooring products will be free of defects in materials and workmanship affecting wearing properties.

1. Moisture Control System: Submit the manufacturer's standard warranty form for ten (10) years from the date of Substantial Completion stating that the flooring products will be free of defects in materials and workmanship affecting flooring installation and performance.

PART 2 - PRODUCTS

2.1 FLOORING PRODUCTS

A. Heterogeneous Sheet Vinyl Flooring:

1. Design Basis Product: Armstrong Timberline.
2. Performance Criteria:
   a. Type: ASTM F 1303; Class A Backing, Grade 1, Type I.
   b. Surface Treatment: PUR coated.
   c. Critical Radiant Flux: ASTM E 662, greater than 0.45 watts per sq. cm., NFPA Class 1.
   d. Smoke Density: ASTM E 662, less than 450 per ASTM E 648, Class 1.
   e. Roll Width: 1.83 meters
   f. Overall Thickness: 2 mm.
   g. Wear Layer Thickness: 0.55 mm.
   h. Static Load Limit: 750 psi per ASTM F 970.
3. Colors and Patterns: As indicated in the Room Finish Schedule.
4. Seaming Method: Heat welded.

B. Homogeneous Sheet Vinyl Flooring:

1. Design Basis Product: Armstrong Medintech
2. Performance Criteria:
   a. Type: ASTM F 1913 for vinyl sheet without backing.
   b. Overall Thickness: 2 mm.

c. Roll Width: 1.83 meters
d. Gloss: 60 degrees specular; approximately 5-15.
e. Critical Radiant Flux: ASTM E 662, greater than 0.45 watts per sq. cm., NFPA Class 1.
f. Smoke Density: ASTM E 662, less than 450 per ASTM E 648, Class 1.
g. Static Load Limit: 750 psi per ASTM F 970.

3. Colors and Patterns: As indicated in the Room Finish Schedule.
4. Seaming Method: Heat welded.

C. Homogeneous Sheet Vinyl Flooring:

1. Design Basis Product: Armstrong Medley.
2. Performance Criteria:
   a. Type: ASTM F 1913 for vinyl sheet without backing.
   b. Overall Thickness: 2 mm.
   c. Roll Width: 1.83 meters
   d. Gloss: 60 degrees specular; approximately 5-10.
   e. Critical Radiant Flux: ASTM E 662, greater than 0.45 watts per sq. cm., NFPA Class 1.
   f. Smoke Density: ASTM E 662, less than 450 per ASTM E 648, Class 1.
   g. Static Load Limit: 750 psi per ASTM F 970.
3. Colors and Patterns: As indicated in the Room Finish Schedule.
4. Seaming Method: Heat welded.

D. Linoleum Floor Covering in accordance with ASTM F 2034, Type I:

1. Homogeneous sheet flooring of primarily natural materials consisting of linseed oil, wood flour, and rosin binders, mixed and calendered onto a polyester backing. Pattern and color shall extend throughout total thickness of tile material.
   a. Design Basis Product: Armstrong Marmorette.
2. Gauge: 1/10" (2.5 mm).
3. Backing: Polyester backing.
4. Pattern and Color: As selected by the Architect from the manufacturer's full range.
5. Adhesive: Similar to Forbo Industries, Inc., L910 adhesive.
6. Heat Welding Rod: Similar to Forbo Industries, Inc., Marmoweld color-matched welding rod.
7. Integral-Flash-Cove-Base Accessories: Cove and metal cap strip as scheduled.
8. Protective Coating: Manufacturer's recommended water-based coating.

2.2 INSTALLATION MATERIALS

A. Flooring Underlayment: One part, self-leveling, portland cement based underlayment provided or approved by the respective sheet flooring manufacturer for applications indicated. Verify compatibility of underlayment with underlayments that may be specified under Division 03 Sections.

B. Adhesives: Unless otherwise indicated, type as recommended by manufacturer to suit product and substrate conditions indicated.

C. Heat-welding Bead: Solid-strand product of sheet covering manufacturer. Color shall be as selected by Architect from manufacturer's full range.

D. Moisture Control System (Design Basis): Consisting of Ardex Feather Finish Self-drying Cement-based Finishing Underlayment, Ardex MC Moisture Control System, and Ardex K 15 Self-leveling Underlayment Concrete applied in strict accordance with the manufacturer's printed directions only by installers certified and approved by the manufacturer.

1. Concrete surfaces to receive the Ardex MC shall be prepared by shotblasting to achieve a level 3 profile. The Ardex MC shall be applied by roller. The Ardex K 15 shall be applied over the entire Ardex MC surface at an approximate 1/4" thickness. If necessary to achieve slope and transitions, apply Ardex Feather Finish over the Ardex K 15.
2. Acceptable Alternate System: Koester VAP1 2000 Waterproofing System applied in strict accordance with the manufacturer's printed directions only by installers certified and approved by the manufacturer.
3. The Architect will only consider products of the Moisture Control System of a sole manufacturer that are intended to be part of an entire system. Using products within the Moisture Control System of different manufacturers is prohibited.

E. Integral-Flash-Cove-Base Accessories:

1. Cove Strip: Radius provided or approved by floor covering manufacturer.
2. Cap Strip: Square metal, linoleum, vinyl, or rubber cap provided or approved by floor covering manufacturer.
3. Corners: Metal inside and outside corners and end stops provided or approved by floor covering manufacturer.

F. Transitions: Provide smooth, flush transitions between sheet vinyl, porcelain tile and carpet. Transitions strips to be Schluter-Schiene-AE, satin anodized aluminum in appropriate heights for the transition of adjacent materials.

G. Flooring manufacturer's recommended slip sheet, reinforcing, or underlayment treatment under resilient sheet flooring at flooring substrate at foundation / slab on grade at perimeter as detailed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates prior to installation for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of sheet coverings.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare concrete substrates to receive flooring according to each respective manufacturer's written recommendations and ASTM F 710 Practice for Preparing Concrete Floors to Receive Resilient Flooring to ensure adhesion of resilient sheet flooring.

1. Mechanically abrade the substrate so as to achieve a profile equal to CSP 3-5 in accordance with ICRI Guidelines 03732 of the International Concrete Repair Institute.
2. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
3. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

B. Testing Agency: Owner will engage a qualified, independent testing agency to perform the following tests and inspections:

1. Verify that concrete substrates are prepared according to ASTM F 710.
2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer to achieve the acceptable pH levels. Proceed with installation only after substrates pass testing.
3. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lbs., of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
4. For each application conduct tests (per ASTM C109) to verify that compressive strength of self-leveling underlayment concrete is equivalent to compresseive strenght of related concrete substrate.
5. For random samplings of self-drying cement based finishing underlayment (Feather Finish), manufacturer shall conduct Fourier Transform-Infrared Testing (FTIR) to confirm proper water ratio per manufacturer’s requirements.

C. Use trowelable cementitious type leveling and patching compound as specified herein to fill cracks, holes, and depressions in substrates. Remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install sheet flooring products until they are same temperature as space where they are to be installed. Move sheet flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by sheet flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected; and satisfactory RH lefels of concrete structure and compressive strength of self leveling underlayment concrete are obtained per manufacurer’s requirements. Flooring may proceed over self drying cement prior to FTIR testing results, with understanding that flooring will be removed, substrate repaired, and flooring replaced at contractor expense.

3.3 INSTALLATION

A. Unroll sheet floor coverings and allow them to stabilize before cutting and fitting.

B. Lay out sheet floor coverings as follows:

1. Maintain uniformity of floor covering direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least away from parallel joints in floor covering substrates.
3. Match edges of floor coverings for color shading at seams.
4. Avoid cross seams.

C. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.

D. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.

E. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.

F. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

H. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.

1. The acceptable tolerance for heat-welded joint widths shall be 1/32 inch to 1/16 inches so as to accommodate the precise cutting and fitting of floor material necessary to achieve the Architect's desired pattern.

I. Integral Flash Cove Base: Cove floor coverings 4 inches up vertical surfaces. Support floor coverings at horizontal and vertical junction by cove strip. Butt at top against cap strip.

1. Install metal corners at inside and outside corners.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing floor covering installation:

1. Remove adhesive and other blemishes from floor covering surfaces.
2. Sweep and vacuum floor coverings thoroughly.
3. Damp-mop floor coverings to remove marks and soil. Do not wash floor coverings until after time period recommended by manufacturer.

B. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. If required, apply protective floor polish to surfaces that are free from soil, visible adhesive, and blemishes if recommended in writing by manufacturer.
2. Cover floor coverings with undyed, untreated building paper until Substantial Completion.

C. Do not move heavy and sharp objects directly over floor coverings. Place plywood or hardboard panels over floor coverings and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 096516

SECTION 096813 – CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections: Division 09 Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet.

1.2 SUMMARY

A. This Section includes:

1. Broadloom carpet.
2. Carpet tile.
3. Carpet walk-off mat.
4. Accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated including adhesives to be used with each type of flooring specified herein. Product data shall indicate applicable compressive strength for floor underlayment.

B. Shop Drawings: Show the following for each type of product specified:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
2. Carpet type, color, and dye lot.
3. Locations where dye lot changes occur.
4. Seam locations, types, and methods.
5. Type of installation.
6. Pattern type, repeat size, location, direction, and starting point.
7. Pile direction.
8. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile (including tiles used in walk-off mat): Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).
2. Broadloom Carpet: Full-width rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).
4. Exposed Edge Stripping: 12-inch- (300-mm-) long Samples.

D. Maintenance Data: For each type of carpet material to include in the Owner's maintenance manuals. Include the following:

1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

B. Pre-installation Conference: Conduct a pre-installation conference at the Project site to review coordination issues related to the Work of this Section.

1. Meet with Owner, Architect, testing and inspecting agency representative, flooring Installer, flooring system manufacturer's representative, and installers of related work that interfaces with or affects the flooring installations specified herein.
2. Review methods and procedures related to each type of flooring installation, including the respective manufacturer's written instructions.
3. Obtain written approval of concrete substrate condition from the manufacturer's representative prior to commencing installation of each carpet flooring material.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

A. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."

B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

D. Where items are indicated for installation on top of carpet, install carpet before installing these items.

1.7 WARRANTY

A. Warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Submit a written warranty, signed by the respective carpet manufacturer agreeing to replace carpet that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPETING AND ACCESSORIES

A. CPT-1: Carpet Tile (Design Basis): Mannington Drape.

B. CPT-2: Broadloom Carpet (Design Basis): Tandus Grama Striae.

C. Carpet Walk-off Mat (Design Basis): Mannington Ruffian II, consisting of carpet tiles, 24” x 24”.

D. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for transitions between carpet and ceramic tile; stainless-steel, ASTM A 666, 300 Series exposed-edge material.

E. Resilient Edge Strips: Vinyl or rubber reducer strips for transitions between carpet and resilient flooring.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of sheet coverings.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare concrete substrates according to each respective manufacturer's written recommendations and ASTM F 710 Practice for Preparing Concrete Floors to Receive Resilient Flooring to ensure adhesion of carpeting.

1. Mechanically abrade the substrate so as to achieve a profile equal to CSP 3-5 in accordance with ICRI Guidelines 03732 of the International Concrete Repair Institute.
2. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

3. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

B. Testing Agency: Owner will engage a qualified testing agency to perform the following tests and inspections:

1. Verify that concrete substrates are prepared according to ASTM F 710.
2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer to achieve the acceptable pH levels. Proceed with installation only after substrates pass testing.
3. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
   a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lbs., of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
   b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Use trowelable cementitious type leveling and patching compound as specified herein to fill cracks, holes, and depressions in substrates. Remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install sheet flooring products until they are same temperature as space where they are to be installed. Move sheet flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by sheet flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Direct-glue-down Installation: Comply with CRI 104, Section 8, "Direct Glue-Down Installation."

B. Carpet Tile: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

C. Install carpet walk-off mat in accordance with the manufacturer’s printed directions and approved Shop Drawings.

D. Comply with carpet manufacturer's written recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position. Bevel adjoining border edges at seams with hand shears.

E. Do not bridge building expansion joints with carpet.

F. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.

G. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

H. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

I. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
2. Remove yarns that protrude from carpet surface.
3. Vacuum carpet using commercial machine with face-beater element.

B. Protect installed carpet to comply with CRI 104, Section 15, "Protection of Indoor Installations."

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

END OF SECTION 096813

SECTION 097500 – STONE FACING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes stone for the interior fireplace hearth.

1.3 STONE TYPE

A. Woodbury Granite by Genest or Architect Approved Equal

B. Thickness: 4”

C. Color/Style to be chosen by Architect from Manufacturers Selection

1.4 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or II. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or III, and hydrated lime complying with ASTM C 207.

1. For pigmented mortar, use a colored portland cement-lime mix as required to produce color indicated or, if not indicated, as selected from manufacturer's standard formulations.
    a. Pigments shall be composed of natural or synthetic iron oxides, compounded for use in mortar mixes, and with a record of satisfactory performance in stone mortars.
    b. Pigments shall not exceed 10 percent of portland cement by weight.

D. Aggregate: ASTM C 144 and as follows:

1. For pointing mortar, use aggregate graded with 100 percent passing No. 16 sieve.
2. White Aggregates: Natural white sand or ground white stone.

E. Mortar Pigments: Natural or synthetic iron oxides, compounded for use in mortar mixes and with a record of satisfactory performance in stone mortars.

F. Water: Potable.

1.5 GROUT

A. Grout Colors: Match stone, unless otherwise indicated.

B. Dry-Set Grout (Unsanded): ANSI A118.6, for materials described in Paragraph H-2.3, for joints 1/8 inch and narrower.

1.6 STONE ACCESSORIES

A. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.

1.7 STONE FABRICATION, GENERAL

A. Fabricate interior stone facing in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.

B. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association.

1. Clean sawed backs of stones to remove rust stains and iron particles.
2. Dress joints straight and at right angle to face, unless otherwise indicated.

C. Finish exposed faces and edges of stone to comply with requirements indicated for finish of each type of stone required and to match approved samples.

D. Hearth shall project from the wall 8” to 12”, as determined by the Architect.

1.8 MORTAR AND GROUT MIXES

A. Mortar: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.

1. Do not use admixtures or other admixtures, unless otherwise indicated. Do not use calcium chloride.
2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer, unless otherwise indicated. Discard mortar when it has reached initial set.

B. Pointing Mortar: Comply with ASTM C 270, Proportion Specification, for types of mortar indicated. Provide pointing mortar mixed to match Architect's sample and complying with the following:

1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.
2. Packaged Portland Cement-Lime Mix Mortar: Use portland cement-lime mix of selected color.
3. Type: N.
4. Mix Proportions: 1 part portland cement and 2-1/2 to 4 parts lime with aggregate ratio of 2-1/4 to 3 times volume of cement and lime.

C. Joint Grout: Comply with mixing requirements of referenced ANSI standards and manufacturer's written instructions.

END OF SECTION 097500

SECTION 099123

PAINTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Exposed exterior items and surfaces with low VOC coatings.
   2. Exposed interior items and surfaces with low VOC coatings.
   3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Related Sections include the following:
   1. Division 2 Sections for traffic-marking paint.
   2. Division 4 Section "Unit Masonry Assemblies" for preparation of concrete masonry.
   3. Division 5 Section "Structural Steel" for shop priming structural steel.
   4. Division 5 Section "Metal Deck" for shop finish on metal deck to be field finished.
   5. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
   6. Division 6 Section "Finish Carpentry" for surface preparation of exterior porch railings, window sills, and interior finish carpentry.
   7. Division 8 Section "Steel Doors and Frames" for factory priming steel doors and frames.
   8. Division 9 Section "Gypsum Board Assemblies" for surface preparation of gypsum board.
   9. Review all sections for shop primed items requiring field painting.

1.03 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
   1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
   2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
   3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
   4. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
   5. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.04 SUBMITTALS

A. General: Submit in accordance with Section 013300.

B. Product Data: For each paint system indicated. Include block fillers and primers. Include manufacturer's printed statement of VOC content for each product.
   1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
   2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
   3. Mix Code: Provide color mix codes for all paint colors.

C. Schedule: Provide schedule of all surfaces to be coated, with prime and finish coat material listed, and manufacturer's recommended wet film thickness.

D. Samples: For each type of exposed finish required, submit color chips, 3- by 5-inches, matching colors indicated on Finish Schedule.

E. Qualification Data: For Applicator.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced Applicator who has completed painting system applications similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers and undercoat materials for each coating system from the same manufacturer as the finish coats.

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Duplicate finish of approved sample Submittals.
   1. Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.
      a. Wall Surfaces: Provide samples of at least 100 sq. ft.
      b. Small Areas and Items: Architect will designate items or areas required.
   2. After permanent lighting and other environmental services have been activated, apply benchmark samples, according to requirements for the completed Work. Provide required sheen, color, and texture on each surface.
      a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.
   3. Final approval of colors will be from benchmark samples.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Manufacturer's stock number and date of manufacture.
   4. Contents by volume, for pigment and vehicle constituents.
   5. Thinning instructions.
   6. Application instructions.
   7. Color name and number.

8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage area neat and orderly.
   2. Remove oily rags and waste daily.
   3. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.07 PROJECT CONDITIONS

A. Apply paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.

B. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.
   2. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before proceeding with or continuing coating operation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

B. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
   1. Benjamin Moore & Company (Moore).
   2. ICI Dulux Paints (ICI).
   3. Sherwin-Williams Co. (S-W).

2.02 COATINGS MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best quality coating material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
   1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers listed in the specification schedule. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

2. Where schedule says no substitution, use proprietary product only. Do not propose substitution, as the products from the other manufacturers have been considered, and are not acceptable.

C. VOC Compliance: Paints and coatings used on the interior of the building (defined as inside of the weatherproofing system and applied on-site) shall comply with the following criteria:
   1. Architectural paints, coatings and primers applied to the interior walls and ceilings: Do not exceed the VOC content limits established in Green Seal Standard GS-11, Paints, First Edition, May 20, 1993.
      a. Flats: 50 g/L
      b. Non-Flats: 150 g/L
   2. Anti-corrosive ant anti-rust paints applied to interior ferrous metal substrates: Do not exceed the VOC content limit of 250 g/L established in Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997.
   3. Clear wood finishes, floor coatings, stains, and shellacs applied to interior elements: Do not exceed the VOC content limits established in South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004.
      a. Clear wood finishes: Varnish 350 g/L; Lacquer 550 g/L
      b. Floor coatings: 100 g/L
      c. Sealers: Waterproofing sealers 250 g/L; Sanding sealers 275 g/L; all other sealers 200 g/L
      d. Shellacs: Clear 730/g/L; Pigmented 550 g/L
      e. Stains 250 g/L

C. Colors: Provide color selections made by the Architect.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, under which painting will be performed for compliance with paint application requirements.
   1. If unacceptable conditions are encountered, prepare written report, endorsed by Applicator, listing conditions detrimental to performance of work.
   2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   3. Application of coating indicates Applicator's acceptance of surfaces and conditions within a particular area.
   4. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of specified finish materials to ensure use of compatible primers.
   1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.02 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
   1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
   1. Provide barrier coats over incompatible primers or remove and reprime.
   2. Cementitious Materials: Prepare concrete, and concrete unit masonry surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze.
      a. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
      b. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
      c. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
   3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
      a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
      b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
      c. If transparent finish is required, backprime with spar varnish.
   4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
      a. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
      b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
   5. Galvanized Surfaces: Uniformly abrade galvanized surfaces with a palm sander and 60 grit aluminum oxide so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
      a. Clean field welds with nonpetroleum-based solvents so surface is free of oil and surface contaminants.

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

3.03 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
9. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer over metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Paint all exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color-coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment at all locations except mechanical and electrical rooms.

D. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
   1. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

E. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions. Walls shall have roller finish.
   1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
   2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
   3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

F. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

G. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in occupied spaces (outside mechanical and electrical rooms).

H. Mechanical items to be painted include, but are not limited to, the following:
   1. Piping, pipe hangers and supports.
   2. Heat exchangers.
   3. Tanks.
   4. Ductwork, including interior of ductwork visible through air devices.
   5. Insulation.
   6. Motors and mechanical equipment.
   7. Exposed rooftop units.
   8. Accessory items.

I. Electrical items to be painted include, but are not limited to, the following:
   1. Conduit and fittings.
   2. Switchgear.
   3. Panelboards.

J. Block Fillers: Apply block fillers to concrete masonry units at a rate to ensure complete coverage with pores filled.

K. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

L. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

M. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
1. Provide satin finish for final coats, unless otherwise noted.

N. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

O. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

P. Exterior Ferrous Metal Items to Be Painted Include, but Are Not Limited To, the Following (New and Existing):
1. Exposed structural steel and lintel plates.
   a. Galvanized single angle lintels do not require painting.
2. Steel doors and frames.
3. Bollards.
4. Metal Fabrications. See Section 05500.
5. Factory primed louvers.
6. Miscellaneous metal items, including galvanized steel.

Q. Interior Ferrous Metal Items to Be Painted Include, but Are Not Limited To, the Following:
1. Steel doors and frames, including frames for borrowed lites.
2. Steel stairs, including risers and stringers.
3. Handrails and guardrails.
4. Lintel plates and angles.
5. Exposed construction, including metal deck.
6. Wood door glass lite kits and astragals.
7. Access panels (both sides).
8. Metal fabrications. See Section 05500.
9. Miscellaneous metal items.

3.04 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the Project site.
1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.05 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
   1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 LOW VOC EXTERIOR PAINT SCHEDULE (See 2.02.C for VOC Requirements)

A. Concrete (Other Than Concrete Unit Masonry): Provide the following finish systems over exterior concrete substrates:
   1. Flat, Sand Textured Acrylate Finish: 2 finish coats over a filler as required.
      a. Concrete Filler: Fill voids, bug holes and other cavities with epoxy modified mortar.
         1) Tnemec: Series 218 MortarClad.
      b. First and Second Coats: Flat, sand textured, exterior, modified waterborne acrylate paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
         1) Tnemec: Series 157 Enviro-Crete; 8.0 mils per coat.

B. Exterior Gypsum Soffit Board: Provide the following finish systems over exterior gypsum soffit board:
   1. Flat Acrylic Finish: 2 finish coats over an exterior, alkyd- or alkali-resistant primer, as recommended by the manufacturer.
      a. Primer: Exterior, alkyd- or alkali-resistant, acrylic-latex primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
         1) Moore: Moorcraft Super Spec Latex Exterior Primer No. 169; 1.4mils DFT.
         2) ICI: 2000-1200 Dulux Professional Exterior 100% Acrylic Latex Primer; 1.6 mils DFT.
         3) S-W: A-100 Exterior Latex Wood Primer B42W41; 1.4 mils DFT.
      b. First and Second Coats: Flat, exterior, acrylic-emulsion paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
         1) Moore: Moorcraft Super Spec Exterior Flat Latex House Paint No. 189; 2.4 mils DFT.
         2) ICI: 2200-XXXX Dulux Professional Exterior 100 Percent Acrylic Flat Finish; 2.8 mils DFT.
         3) S-W: Duration Exterior Latex Coating; 5.6 mils DFT.

C. Wood Trim, Opaque Finish: Provide the following finish systems over smooth, exterior wood surfaces:
   1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a primer.
      a. Primer: Exterior, stain blocking, alkyd, wood primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
         1) Moore: Moorcraft Super Spec Alkyd Exterior Primer No. 176; 1.8 mils DFT.
         2) ICI: 2110-1200, Ultra-Hide Durus Exterior Alkyd Primecoat; 1.4 DFT.
         3) S-W: A-100 Exterior OilWood Primer Y24A100; 2.3 mils DFT.

b. First and Second Coats: Semigloss, waterborne, exterior, acrylic enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
   1) Moore: Moorcraft Super Spec Latex House & Trim Paint No. 170; 2.2 mils DFT.
   2) ICI: 2416-XXXX, Ultra-Hide Durus Exterior Acrylic Semi-Gloss Finish; 3.0 mils DFT.
   3) S-W: Duration Exterior Satin Latex Coating; 5.6 mils DFT.

D. Fiber-Cement Siding and Trim: Provide the following finish systems over exterior fiber-cement substrates:
1. Low-Luster Acrylic Finish: 1 coat of acrylic finish over shop applied primer and first finish coat specified in Division 7 Section "Fiber Cement Siding":
   a. Second Finish Coat: Low-luster (eggshell or satin), exterior, 100% acrylic paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 6 mils.
      1) Cabot: The Finish with Teflon Surface Protector, #1700 Series.

E. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a rust-inhibitive primer.
   a. Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: Moore's IMC M04 Acrylic Metal Primer; 2.0 mils DFT.
      2) ICI: 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish; 2.2 mils DFT.
      3) S-W: Galvite HS, B50WZ30; 3.5 DFT.
   b. First and Second Coats: Semigloss, exterior, acrylic-latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: Moorcraft Super Spec Latex House & Trim Paint No. 170; 2.2 mils DFT.
      2) ICI: 2416-XXXX, Ultra-Hide Durus Exterior Acrylic Semi-Gloss Finish; 3.0 DFT.
      3) S-W: Duration Exterior Gloss Latex Coating; 5.6 mils DFT.

F. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated (galvanized) metal surfaces:
1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a primer.
   a. Primer: Metal primer applied to galvanized metals not previously shop-primed applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: Moore's IMC Acrylic Metal Primer No. M04; 2.0 mils DFT.
      2) ICI: 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish; 2.5 mils DFT.
      3) S-W: Galvite HS Paint B50WZ30; 3.5 mils DFT.
   b. First and Second Coats: Semigloss, exterior, acrylic-latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: Moorcraft Super Spec Latex House & Trim Paint No. 170; 2.2 mils DFT.

2) ICI: 2416-XXXX, Ultra-Hide Durus Exterior Acrylic Semi-Gloss Finish; 3.0 DFT.
3) S-W: Duration Exterior Gloss Latex Coating; 5.6 mils DFT.

G. Aluminum: Provide the following finish systems over exterior aluminum surfaces. Primer is not required on shop-primed items.
1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a primer.
a. Primer: Rust-inhibitive, acrylic- or alkyd-based, metal primer, as recommended by the manufacturer for use over aluminum, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
1) Moore: Moore's IMC Acrylic Metal Primer No. M04; 2.0 mils DFT.
2) ICI: 4020-XXXX Devflex DTM Flat Interior/Exterior Waterbcorne Primer & Finish; 2.2 mils DFT.
3) S-W: DTM Acrylic Primer/Finish B66W1; 2.5 mils DFT.
b. First and Second Coats: Semigloss, exterior, acrylic-latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
1) Moore: Moorcraft Super Spec Latex House & Trim Paint No. 170; 2.2 mils DFT.
2) ICI: 2416-XXXX, Ultra-Hide Durus Exterior Acrylic Semi-Gloss Finish; 3.0 DFT.
3) S-W: Duration Exterior Gloss Latex Coating; 5.6 mils DFT.

3.07 LOW ODOR/LOW VOC INTERIOR COATINGS

A. VOC Compliance, General: Provide the manufacturers' formulations for the products specified below that comply with the VOC requirements in paragraph 2.02.C of this Section.

B. Concrete Plank: Provide the following paint systems over interior concrete surfaces:
1. Semigloss, Acrylic-Enamel Finish, Ceilings: 2 finish coats over a block filler.
a. Block Filler: Low odor/low VOC, high-performance, latex-based, block filler applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
1) Moore: Latex Block Filler No. M88; 8.0 mils DFT.
2) ICI: Bloxfil 4000-1000 Interior/Exterior Heavy Duty Acrylic Block Filler; 7.0 mils DFT.
3) S-W: Loxon Block Surfacer A24W200; 8.0 mils DFT.
b. First and Second Coats: Low odor/low VOC, semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
1) Moore: EcoSpec Interior Latex Semi-Gloss Enamel No. 224; 2.8 mils DFT.
2) ICI: 1406-XXXX Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; 3.0 mils DFT.
3) S-W: ProMar 200 Interior Latex Semi-Gloss, B31-2200 Series; 3.0 DFT.

C. Concrete Masonry Units: Provide the following finish systems over interior concrete masonry block units:
1. Semigloss, Acrylic-Enamel Finish, Walls: 2 finish coats over a block filler.

a. Block Filler: Low odor/low VOC, high-performance, latex-based, block filler applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
   1) Moore: Latex Block Filler No. M88; 8.0 mils DFT.
   2) ICI: Bloxfil 4000-1000 Interior/Exterior Heavy Duty Acrylic Block Filler; 7.0 mils DFT.
   3) S-W: PrepRite Block Filler B25W25; 8.0 mils DFT.

b. First and Second Coats: Low odor/low VOC, semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
   1) Moore: Eco Spec Interior Latex Semi-Gloss Enamel No. 224; 2.8 mils DFT.
   2) ICI: 1406-XXXX Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; 3.0 mils DFT.
   3) S-W: ProMar 200 Interior Latex Semi-Gloss, B31-2200 Series; 3.0 DFT.

D. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
1. Semigloss, Acrylic-Enamel Finish, Walls and Ceilings: 2 finish coats over a primer.
   a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: EcoSpec Interior Latex Primer Sealer No. 231; 1.0 mils DFT.
      2) ICI: 1030-1200, Ultra-Hide PVA Interior Primer-Sealer General Purpose Wall Primer; 1.9 mils DFT.
      3) S-W: PrepRite 200 Interior Latex Primer B28W200 Series; 1.6 mils DFT.
   b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product. Ceiling paint shall contain mildewcide.
      1) Moore: EcoSpec Interior Latex Semi-Gloss Enamel No. 224; 2.8 mils DFT.
      2) ICI: 1406-XXXX Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; 3.0 mils DFT.
      3) S-W: ProMar 200 Interior Latex Semi-Gloss, B31-2200 Series; 3.0 DFT.

E. Natural-Finish Woodwork: Provide the following natural finishes over new, interior woodwork:
1. Waterborne, Satin-Varnish Finish: 3 finish coats of a waterborne, clear-satin varnish.
   a. First, Second and Third Finish Coats: Waterborne, varnish finish applied at spreading rate recommended by the manufacturer.
      1) Moore: Stays Clear Acrylic Polyurethane #423, Satin.
      2) ICI: WoodPride Aquacrylic 1802-0000.
      3) S-W: Minwax Polycrylic.

F. Ferrous and Zinc-Coated Metal: Provide the following finish systems over ferrous metal:
1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a primer.
   a. Primer: Quick-drying, corrosion resistant, acrylic primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the

manufacturer to achieve a total dry film thickness of not less than indicated for product.

1) Moore: I.M.C. Acrylic Metal Primer M04; 2.0 mils DFT.
2) ICI: 4020-XXXX DTM Flat Interior/Exterior Waterborne Primer & Finish; 3.0 mils DFT.
3) S-W: Pro-Cryl Universal Water Based Primer, B66-310 Series; 3.0 mils DFT.

b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.

1) Moore: Eco Spec Interior Latex Semi-Gloss Enamel No. 224; 2.8 DFT.
2) ICI: 1406-XXXX Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; 3.0 mils DFT.
3) S-W: ProMar 200 Interior Latex Semi-Gloss B31-2200 Series; 3.0 mils DFT.

G. Telecommunication and Electrical Backboards: Provide the following finish over plywood:

1. Flat Intumescent Finish: Two finish coats over a primer.
   a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: Pristine EcoSpec Interior Latex Primer Sealer 231; 0.8 mils DFT.
   b. First and Second Coats: Intumescent-type, fire-retardant paint applied at spreading rate recommended by manufacturer to achieve a total dry film thickness of not less than 4 mils; white color for telecommunication and black for electrical.
      1) Moore: M59 220 Latex Fire-Retardant Coating.

H. Fire-Rating Identification: Identify all 1- and 2-hour fire-rated partitions by stenciling rating on each side of rated walls above ceiling line with 4 inch high, Helvetica Bold letters in red or orange semigloss paint; each rated wall shall be identified at least once and at a spacing not greater than 12'-0" o.c.

1. First Coat: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
   a. Moore: Eco Spec Interior Latex Semi-Gloss Enamel No. 224; 1.4 DFT.
   b. ICI: 1406-XXXX Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; 1.5 mils DFT.
   c. S-W: ProMar 200 Interior Latex Semi-Gloss B31-2200 Series; 1.5 mils DFT.

I. Floor Identification for Stairwell Doors: Identify floor level on stairwell side of each stairwell door by stenciling doors with 12 inch high, Helvetica Bold letters at center of door in black semigloss paint.

1. First Coat: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
   a. Moore: Eco Spec Interior Latex Semi-Gloss Enamel No. 224; 1.4 DFT.
   b. ICI: 1406-XXXX Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; 1.5 mils DFT.
   c. S-W: ProMar 200 Interior Latex Semi-Gloss B31-2200 Series; 1.5 mils DFT.

Paint				
	Benjamin Moore	ready mix	Ceiling - white	PT0
	Benjamin Moore	TBD		PT1
	Benjamin Moore	TBD		PT2
	Benjamin Moore	TBD		PT3
	Benjamin Moore	TBD		PT4
	Benjamin Moore	TBD		PT5
	Benjamin Moore	TBD		PT6
	Benjamin Moore	TBD		PT7
	Benjamin Moore	TBD		PT8
	Benjamin Moore	TBD		PT9
		TBD		PT10

END OF SECTION 099123

SECTION 101100 – VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes magnetic markerboard and accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Show location of panel joints.
2. Include sections of typical trim members.

C. Samples: For each type of visual display surface indicated and as follows:

1. Visual Display Surface: Not less than 8-1/2 by 11 inches, mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
2. Trim: 6-inch- long sections of each trim profile.
3. Accessories: Full-size Sample of each type of accessory.

D. Maintenance Data: For visual display surfaces to include in the Owner's maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store visual display units vertically with packing materials between each unit.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

PART 2 - PRODUCTS

2.1 MARKERBOARDS AND ACCESSORIES

A. Magnetic markerboards with a low-gloss magnetic steel surface laminated to a 5/8” thick MDF substrate.

B. Marker Tray: Box type, extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance.

B. Examine walls and partitions for proper backing for visual display surfaces.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove dirt, scaling paint, projections, and depressions that will affect smooth, finished surfaces of visual display boards.

B. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, and substances that will impair bond between visual display boards and surfaces.

3.3 INSTALLATION, GENERAL

A. Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

1. Mounting Height: 36 inches above finished floor to bottom of markerboard, unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 101100

SECTION 101200 - BULLETIN CASES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Glass-enclosed bulletin cases with tackable back panel.

1.3 REFERENCES

A. ANSI H35.1 - Alloy and Temper Designation for Aluminum.

B. ASTM B 221 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

C. ASTM E-84 – Standard Testing Method for Surface Burning Characteristics of Building Materials.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of bulletin case indicated, provide technical data & materials test reports where applicable. Include data on regular cleaning, stain removal and general maintenance recommendations.

B. Shop Drawings:

1. Submit shop drawings for each case style required. Include dimensional elevations.
2. Show anchors, grounds, reinforcement, and installation details.

C. Samples:

1. Manufacturer’s color charts showing the full range of colors and textures available for the following:
2. Interior Wall Materials: Furnish swatches for the following:
   a. Fabric: Guilford of Maine panel 2100- FR701 standard panel fabric color range.
   b. Natural Cork: 1/4-inch (6.35-mm) thick face-sanded natural cork.
   c. Housing and Door Trim: Clear satin aluminum Samples on 6-inch (150-mm) long sections.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced crew with installation and maintenance experience of the type of product as required for this Project.

B. Fire-Test-Response Characteristics: For vinyl/fabric-faced tack surfaces, provide Class A performance characteristics identical to those required in this Section per ASTM E 84.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver factory built units crated for protection and secured to the trailer whenever possible. Once delivered, inspect the unit for damage and return to crating for storage. Store crated units protected from temperature (above 55 degrees F) and humidity variations or possible jobsite traffic damage until the system is ready to be installed.

1.7 PROJECT CONDITIONS

A. Verify field measurements before fabrication to ensure proper fitting. Coordinate fabrication lead time with construction progress to avoid delaying the work. Notify Architect of any conflicts with other construction.

1. Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with the fabricating without field measurements. Coordinate wall construction to ensure actual dimensions correspond to established dimensions.
2. Coordinate delivery with field conditions to provide proper temperature (above 55 degrees F and humidity variations and protect from possible jobsite traffic damage until the system is ready to be installed.

PART 2 - PRODUCTS

2.1 DESIGN BASIS PRODUCT

A. Stargazer Recessed Bulletin Cases as manufactured by Educational Equipment, Kent, OH; www.stargazerdisplaycases.com.

2.2 BULLETIN CASE CONSTRUCTION

A. Mounting: Recessed-mounted case to wall structure through back plate or case interior sides.

B. Housing:

1. Fabricated frames of not less than 1/8-inch- (3.175-mm-) thick aluminum alloy 6063-T5 extrusions meeting ASTM B221.
2. Finish: Clear satin anodized aluminum.
3. Size: As indicated on the Drawings.
4. Connection: All connection corners shall be double-keyed.

C. Glass Doors: Hinged Glass Door shall be 3/16-inch (4.76-mm) thick tempered safety glass. Miter door frame corners to a neat, hairline closure constructed with double corner-keys for an accurate square and does not require glass to maintain dimensional stability. Attached full-length piano hinge. Cam lock and two keys provided.

D. Back Panel:

1. Consisting of facing material laminated to core laminated to total 1/2-inch (12-mm) thick following factory laminating procedures. Laminating adhesive shall be manufacturer's standard, moisture-resistant, thermoplastic-type adhesive.
   a. Core: Natural cork laminated to fiberboard.
   b. Panel Facing:
      1) Tackable Fabric: Mildew-resistant, Washable fabric weighing not less then 16 oz./lin. yd. Provide Class 1 (A) fabric with a flame-spread rating of 25 or less when tested according to ASTM E-84. Provide color and texture as scheduled or as selected from manufacturer's standard Guilford of Maine Panel Fabric style 2100 – FR701 or as chosen by architect.
      2) Natural Cork: Face-sanded natural granulated cork surface 1/4-inch (6.35-mm) thick.

2.3 FABRICATION

A. Units shall be fully factory-assembled in accordance with dimensions as shown on the Drawings.

B. Aluminum connection points for housing shall be internally braced and sealed so as to achieve tight, hairline fits.

2.4 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Finish designations prefixed by AA conform to the system established by The Aluminum Association for designating aluminum finishes.

C. Aluminum Finish: Class II, Clear Anodic Finish AA-M12C22A31 (Mechanical Finish: Non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating; Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site conditions and verification:

1. Examine wall surfaces, with Installer present, for compliance with requirements and other conditions affecting installation.
2. Verify required anchorage have been installed such as blockings.
3. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Deliver factory-built units completely assembled in accordance with manufacturer's shop drawings as approved by the Architect. When overall dimensions require delivery in separate units, pre-fit components at the factory, disassemble for delivery, and make final joints at the site.

2. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim and accessories necessary for complete installation.
3. Install units in locations and at mounting heights indicated and according to manufacturer' printed directions and approved Shop Drawings. Keep perimeter lines straight, plumb, and level.

3.3 CLEANING AND PROTECTION

A. Remove construction debris from project site and dispose of in accordance to local laws. Clean glass surfaces, housing wall panels and aluminum trim in accordance to manufacturer recommendations leaving all materials ready for owner acceptance.

B. Protection: Properly protect finished surfaces from site damage until date of Substantial Completion.

END OF SECTION 101200

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes baked-enamel metal units as follows:

1. Toilet Enclosures: Floor-mounted and overhead-braced.
2. Urinal Screens: Wall hung.

B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for blocking.
2. Division 10 "Toilet Accessories" for toilet accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to supporting work.

1. Show locations of cutouts for compartment-mounted toilet accessories.
2. Show locations of reinforcements for compartment-mounted grab bars.

C. Samples: Of each type of color and finish required for units, prepared on square Samples of same thickness and material indicated for Work.

1.4 QUALITY ASSURANCE

A. Comply with requirements in CID-A-A-60003, "Partitions, Toilets, Complete."

B. Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

C. In accordance with EQ Credit 4.1, adhesives and sealants used in the Work shall be low-emitting type in accordance with the VOC limits of South Coast Air Quality Management District (SCAQMD) Rule #1168. Submit verification that the VOC content of the material and compliance with the VOC limits specified herein.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 METAL UNITS

A. Baked-enamel Units: Facing sheets and closures fabricated from ASTM A 591/A 591M, 80Z (electrolytically zinc-coated) or ASTM A 653/A 653M (hot-dip galvanized or galvannealed), commercial steel sheet for exposed applications, that is mill phosphatized, and selected for smoothness.

1. Facing Sheet Thicknesses: Minimum base-metal (uncoated) thicknesses as follows:
   a. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than 0.0438 inch.
   b. Panels: Manufacturer's standard thickness, but not less than 0.0269 inch.
   c. Doors: Manufacturer's standard thickness, but not less than 0.0269 inch.
   d. Integral-Flange, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than 0.0269 inch.

2. Finish: Manufacturer's standard pigmented, organic coating, including thermosetting, electrostatically applied, and powder coatings. Provide coating system that complies with coating manufacturer's written instructions for pretreatment, application, baking, and minimum dry film thickness.

   a. Color(s): Custom color(s) as selected by Architect.

B. Toilet Compartment Door, Panel, and Pilaster Construction: Seamless, metal facing sheets are pressure laminated to core material. Units have continuous, interlocking molding strip or lapped and formed edge closures. Exposed surfaces are free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections. Corners are sealed by welding or clips. Exposed welds are ground smooth.

1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch for doors and panels and 1-1/4 inches for pilasters.
2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units.
2. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.
3. Urinal-Screen Construction: Matching panels.

C. Pilaster Sleeves (Caps): Stainless steel, ASTM A 666, Type 302 or 304, not less than 0.0312 inch specified thickness and 3 inches high, finished to match hardware.

D. Brackets (Fittings): Stirrup-type ear or U-brackets, stainless steel.

2.2 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard ADA-AG compliant design, heavy-duty operating stainless steel hardware and accessories.

B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.3 FABRICATION

A. Floor-Anchored and Overhead-braced Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage and leveling mechanism.

B. Doors: Unless otherwise indicated, provide 24-inch- wide in-swinging doors for standard toilet compartments and 36-inch- wide out-swinging doors with a minimum 32-inch- wide clear opening for compartments indicated to be accessible to people with disabilities.

1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:
   a. Pilasters and Panels: 1/2 inch.
   b. Panels and Walls: 1 inch.

B. Floor and Overhead-braced Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor, unless otherwise indicated in manufacturer's written

instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

C. Wall-hung Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 HARDWARE ADJUSTMENT

A. Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102123 - CUBICLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes installing the following Owner-furnished items:

1. Curtain tracks and curtain carriers.
2. Cubicle privacy curtains.

1.3 SUBMITTALS

A. Shop Drawings: Show layout and types of cubicles, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements. Include details on blocking above ceiling.

B. Cubicle Schedule: Use same room designations as indicated on Drawings.

C. Maintenance Data: For tracks and curtains to include in the Owner’s maintenance manuals.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not install cubicles until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where cubicles are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Curtain Carriers and Track End Caps: Full-size units equal to 3 percent of amount installed for each size indicated, but not less than 10 units.

2. Curtains: Full-size units equal to 10 percent of amount installed for each size indicated, but not less than 2 units.

PART 2 - PRODUCTS

2.1 CURTAIN TRACKS

A. Cubicle curtain track system is based on Clickeze System by Inpro Corp., unless otherwise indicated.

B. Track: Heavy duty extruded white PVC track similar to Whisper Cube Cubicle Track CE9000 by Inpro Corp.

C. Track Accessories: Fabricate splices, bends, ceiling clips, and other accessories as required for a complete installation, including the following accessories, without limitation:

1. Inpro Gridclip Tegular Tiles CE9271 for use with tegular ceiling panels.
2. Inpro Swivel Clip Tegular Tiles CE9273 for use with tegular ceiling panels.
3. Curtain Carriers: White self-lubricating Delrin with molded-on hook similar to Canted Wheel Carrier CE9025 by Inpro Corp.
4. Exposed and Concealed Fasteners: Stainless steel.

2.2 CURTAINS AND ACCESSORIES

A. Curtains: As indicated in the Room Finish Schedule.

B. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches o.c.; machined into top hem.

2.3 CURTAIN FABRICATION

A. Fabricate curtains to comply with the following requirements:

1. Open Mesh Cloth: No. 50 (1/2-inch hole) open weave to permit air circulation; flameproof material, same color as curtain or Architect to select from manufacturers standard colors. Height shall be 18 inches, unless otherwise indicated.
2. Width: Equal to track length from which curtain is hung plus 10 percent added fullness, but not less than 12 inches added fullness.
3. Length: Equal to floor-to-ceiling height minus depth of track and carrier at top, and minus 12 inches above finished floor at bottom.
4. Top Hem: Top hem not less than 1 inch and not more than 1-1/2 inches wide, triple thickness, reinforced with integral web, and double lock stitched. Double lock stitch bottom of mesh
5. Include open mesh at top 20 inches of curtain for room air circulation. Mesh top with metal grommet holes for carriers. Reinforce attachment of mesh to curtain for maximum strength.

6. Bottom Hem: Not less than 1 inch and not more than 1-1/2 inches wide, double thickness and single lock stitched. Hem shall be weighted, if required.
7. Side Hems: Not less than 1/2 inch and not more than 1-1/4 inches wide, with double turned edges, and single lock stitched.
8. Vertical Seams: Not less than 1/2 inch wide, double turned and double stitched.
9. Thread to match curtain color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Determine that related work in place is not detrimental to the timely completion of the Work of this Section. Start of Work shall indicate acceptability of related work.

3.2 INSTALLATION

A. Install surface-mounted tracks level and plumb, according to manufacturer's written instructions and approved Shop Drawings. Provide track fabricated from one continuous length up to 16 feet.

B. Surface Track Mounting: Fasten surface-mounted tracks at intervals of not less than 24 inches. Fasten support at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Attach track to ceiling by mechanically fastening to furring through suspended ceiling with screw and tube spacer.

C. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.

D. Curtain Carriers: Provide curtain carriers adequate for 6-inch spacing along the full length of the curtain plus an additional carrier.

E. Curtains: Hang curtains on each curtain track.

END OF SECTION 102113

SECTION 102600 – WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes corner guards.

1.3 SUBMITTALS

A. Product Data: Include physical characteristics, such as durability, resistance to fading, and flame resistance, for each impact-resistant wall protection system component indicated.

B. Shop Drawings: Show locations, extent, and installation details of each impact-resistant wall protection system component. Show methods of attachment to adjoining construction.

C. Samples: For specified products, showing the full range of color and texture variations expected in each system component. Prepare Samples from the same material to be used for the Work.

D. Maintenance Data: For each impact-resistant wall protection system component to include in the Owner's maintenance manuals.

1. Include recommended methods and frequency for maintaining optimum condition of vinyl plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to vinyl plastic finishes and performance.

E. Submit Product Data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing impact-resistant wall protection system components similar to those required for this Project and with a record of successful in-service performance during the immediate past 5 years.

B. Source Limitations: Obtain each color, grade, finish, and type of impact-resistant wall protection system component from a single source with resources to provide components of consistent quality in appearance and physical properties.

C. Fire-Test-Response Characteristics: Provide impact-resistant wall protection system components with the following surface-burning characteristics, as determined by testing materials identical to those required in this Section per ASTM E 84 by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify impact-resistant wall protection system components with appropriate markings of applicable testing and inspecting agency.

1. Flame Spread: 25 or less.
2. Smoke Developed: 450 or less.

D. Impact Strength: Provide impact-resistant wall protection system components with a minimum impact resistance of 25.4 ft-lbf/in. (1356 J/m) of width when tested according to ASTM D 256, Test Method A.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store wall surface-protection materials in original undamaged packages and containers inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within the storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored.
2. Store corner-guard covers in a vertical position for a minimum of 72 hours, or until the plastic material attains the minimum room temperature of 70 deg F (21 deg C).

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install wall surface-protection system components until the space is enclosed and weatherproof and ambient temperature within the building is maintained at not less than 70 deg F (21 deg C) for not less than 72 hours before beginning installation. Do not install rigid plastic wall surface-protection systems until that temperature has been attained and is stabilized.

PART 2 - PRODUCTS

2.1 CORNER GUARDS

A. Design Basis Product: 160BN BluNose High Impact Corner Guards by Inpro Corp.

1. Wing Length: 2 inches.
2. Cover: 0.080 inch thick rigid vinyl cover.
3. Mounting: Continuous vinyl retainer, 0.070 inches thick.
4. Height: 48 inches, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions in which impact-resistant wall protection system components and impact-resistant wall covering materials will be installed. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.

B. Impact-resistant Wall Covering Materials: Wall surfaces to receive impact-resistant wall covering materials shall be dry and free from dirt, grease, loose paint, and scale.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before to commencing installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Install impact-resistant wall protection system components level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Install aluminum retainers, mounting brackets, and other accessories according to the manufacturer's written instructions. Where splices occur in horizontal runs of more than 20 feet (6.1 m), splice aluminum retainers and plastic covers at different locations along the run.

3.4 CLEANING

A. Immediately on completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent. Clean metal components according to the manufacturer's written instructions.

B. Remove excess adhesive using methods and materials recommended by the manufacturer.

C. Remove surplus materials, rubbish, and debris, resulting from installation, on completion of work and leave installation areas in neat, clean condition.

END OF SECTION 102600

SECTION 102800 – TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes toilet accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Identify locations using room designations indicated on Drawings.

C. Maintenance Data: For toilet accessories to include in the Owner’s maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

B. Work of this Section shall be in accordance with applicable provisions of the Americans with Disabilities Act Accessibility Guidelines (ADA-AG).

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

A. Mirror Warranty: Manufacturer's standard warranty form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TOILET ACCESSORIES

A. Contractor-furnished, Contractor-installed:

1. Grab Bars: Bradley Model 812; 1-1/2" o.d.; concealed mounting; sizes shown on the drawings.
2. Baby Changing Tables: Koala Model KB200, injection-molded anti-microbial (Microban) polypropylene; surface-mounted; pneumatic cylinder for opening and closing; concealed hinges; nylon strap and two purse hooks.
3. Lead Apron Racks: American Dental Accessories Model 78-CH; wall-mounted; 15" hanger x 11" mounting plate.
4. Coat Hooks: Peter Pepper Products: #2082, ¾" x 1-3/4"h x 1-5/8" d, natural anodized aluminum. (2) in each office, (1) mounted at 4'-0" AFF and (1) mounted at 5'-0" AFF. (3) at each clinical workstation
5. Mop and Broom Holders: Bradley Bradex Model 9953, provide three (3) holders at each janitor room.
6. Mirrors: Bradley Model 747, frameless. Size as indicated on drawings.
7. Specimen Pass-through Cabinets: Bradley Bradex Model 9813, 18 gauge stainless steel cabinet; 20 gauge stainless steel door; interlock mechanism allowing only one door to operated at a time; removable stainless steel spill tray; 13-3/8" wide x 12-5/8" high x 6" deep.

B. Owner-furnished, Contractor-installed:

1. Paper towel dispensers (both roll dispensers and C-fold dispensers).
2. Toilet paper dispensers.
3. Soap dispensers.
4. Hand sanitizer dispensers.
5. Glove box holders.
6. Sharps disposal containers.
7. Waste containers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Determine that related work in place is not detrimental to the timely completion of the Work of this Section. Start of Work shall indicate acceptability of related work.

3.2 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated and complying with applicable ADAAG standards.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.3 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 103000 – FIREPLACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnish and install work of this section including but not limited to manufactured gas fireplaces and accessories.

B. The HVAC Contractor is responsible for the following:

1. Furnish and install Type “B” gas venting for the fireplace.
2. Install power vent fan furnished by the fireplace supplier.
3. Furnish and install roof curb for the power vent fan (induced draft fan).
4. Furnish and install 24-volt wiring associated with the fire place controls.

C. The Electrical Contractor shall provide the following:

1. A weatherproof disconnect switch for the induced draft fan.
2. A 120-volt circuit to the fireplace control panel.
3. A 120-volt wiring from the fireplace control panel to the 1/2 HP induced draft fan on the roof.
4. A 120-volt wiring inside of the fireplace control panel.

D. Related Sections include Division 23 HVAC Specification Sections for work related to the fireplace installation.

1.3 SUBMITTALS

A. Submit manufacturer's Product Data and Shop Drawings showing fireplace materials, accessories, finishes, fabrication, assembly, installation, and anchoring details.

1.4 WARRANTY

A. Submit the manufacturer’s standard warranty form covering defects in materials and workmanship for the following time periods:

1. Fire Box: Ten (10) years from date of Substantial Completion.
2. Burner: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FIREPLACES

A. Design Basis Product: C-view Model BF52, Single-sided Style as manufactured by Montigo, Ferndale, WA in locations as shown on the Drawings. Subject to compliance with requirements, comparable products by the following manufacturers will also be considered:

1. Acucraft Fireplaces, Big Lake, MN.
2. Moberg Fireplaces, Inc., Portland, OR.

B. Glass Size: As determined by the Architect.

C. Features:

1. Glass Size: 52” wide x 36” high.
2. Input: 150,000 Btu/hr.
3. Ceramic fiber logs.
4. High/low burner.
5. Junction box.
6. Gas flex connectors.
7. Manual gas shut-off valve.
8. Junction box.
9. Black hood.
10. Gas flex connector.
11. Control wire.
12. Power Cool Pack Option: PFC-620 Cool Pack, inner and outer glass system with cool air wash forced between so as to reduce glass temperature to 110 degrees F.
13. Venting: Type B venting, terminating on roof with exhaust fan.
14. Automatic dampers on cold air supply side.
15. Combustion air intake introduced using indoor air.
16. Finish: As selected by the Architect from the manufacturer’s full range.
17. Provide curb for fireplace fan.

2.2 INDUCED DRAFT FAN

A. Design Basis Product: Exhausto Model RSV-315, Tjernlund, Fantech.

B. Description: Mechanical draft fan for installation at gas flue vent termination point. ETL listed.

C. Capacity Data: 1,500 CFM at 1” water column external static pressure with 1/2 HP fan motor operating at 120 volt, single phase power supply.

D. Casing: Corrosion resistant, 3/16” thick cast aluminum housing with hinged top for service. Fully weatherproofed for outdoor roof mounted installation.

E. Fan: Backwards curved impeller of cast aluminum construction.

F. Single Phase Motors: Variable speed, split capacitor, totally enclosed type motor with class H insulation, thermal overload protection, and sealed ball bearings.

G. Maximum Operating Temperature at Appliance: 575°F.

H. Accessories for Single Phase Motor Units: Junction box with cover and conduit; bird screen; wall mounted fan speed controller; proven draft switch; steel chimney adapter; and 3/4" neoprene gasket material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with conditions affecting performance of work.

B. Begin fireplace installations only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 FIREPLACE AND ACCESSORY INSTALLATION

A. Install gas fireplaces and accessories as shown in accordance with manufacturer's printed instructions and approved Shop Drawings.

B. Position units level, plumb, secure, and at proper location relative to adjoining work. Securely anchor units with anchorages suited to substrate.

3.3 PROTECTION AND CLEANING

A. Protect fireplace after installation from damage during construction. If damage occurs, remove and replace damaged components or entire unit, to restore unit to original condition.

B. Clean exposed surfaces in strict accordance with manufacturer's printed recommendations.

END OF SECTION 103000

SECTION 104250

SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section includes the following types of signs:

1. Dimensional Letters
2. Exterior Signage Band

1.2 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01300, "Submittals."

B. Product data for each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

C. Shop drawings showing fabrication and erection of exterior metal signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, layout, reinforcement, accessories, and installation details.

1. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
3. Provide message list for each directory required, including large-scale details of wording and lettering layout.

D. Samples: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.

1. Samples for initial selection of color, pattern, and texture:
    a. Dimensional letters.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Design Criteria: Design, fabricate, and install signs to withstand a wind pressure of 100 mph on the total sign area in all directions.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: For each separate sign type required, obtain signs from one source of a single manufacturer.

B. Design Criteria: The Drawings indicate sizes, profiles, and dimensional requirements of signs and are based on the specific types and models indicated. Sign units by other manufacturers may be considered provided deviations in dimensions and profiles do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

A. Design Criteria: Design, fabricate, and install signs to withstand a wind pressure of 100 mph on the total sign area in all directions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work. Use metals that are compatible with one another.

2.2 DIMENSIONAL LETTERS

A. Dimensional Letters

1. Dimensional Letters:
    a. Size: 6” by 3/8” thick.
    b. Material: Polished Aluminum
    c. Mounting: Pad mounted.
    d. Font: Upper Century School Book Bold.
    e. Manufacturer: Gemini, Inc. (1-800-LETTERS) or Architect approved equal.

2.5 EXTERIOR SIGNAGE BAND

A. Exterior Signage Band

1. Copper Sheet or Plate: Provide alloy and temper recommended by the copper producer for the type of use indicated and not less than the strength and durability properties specified in ASTM but not less than 48 ounces.
2. Cutout Copy: Machine-cut letters, numbers, symbols, and other graphic devices through the sign panel to produce precisely formed copy. Use high-speed cutters mechanically linked to master templates in a pantographic system or equivalent process capable of producing

characters of the style indicated with sharply formed edges.

3. Edge Condition: Square.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.

1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

B. Set anchor bolts and other items required for installation post and panel signs. Use templates, setting drawings diagrams, instructions, and directions provided by suppliers of items to be attached.

C. Dimensional Letters and Numbers: Mount letters and numbers using standard fastening methods recommended by the manufacturer for letter form, type of mounting, wall construction, and condition of exposure indicated. Install with fully surfaced rear faced double-stick foam adhesive tape.

1. Projected Mounting: Mount letters at the projection distance from the wall surface indicated.

3.2 CLEANING AND PROTECTION

A. At completion of the installation, clean soiled surfaces of sign units in accordance with the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

END OF SECTION 104250

SECTION 104413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire protection cabinets for the following:

a. Portable fire extinguishers.

B. Related Sections:
1. Division 10 Section "Fire Extinguishers."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
2. Show location of knockouts for hose valves.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For each type of fire protection cabinet indicated.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Size: 6 by 6 inches (150 by 150 mm) square.

E. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function.

F. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

B. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fire protection cabinets including, but not limited to, the following:

a. Schedules and coordination requirements.

1.5 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.

C. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:

1. Sheet: ASTM B 209 (ASTM B 209M).
2. Extruded Shapes: ASTM B 221 (ASTM B 221M).

C. Stainless-Steel Sheet: ASTM A 666, Type 304.

D. Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3, [**3**] [**6**] mm thick.

E. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

F. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

2.2 FIRE PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Fire End & Croker Corporation;
    b. J. L. Industries, Inc., a division of Activar Construction Products Group; .
    c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc;
    d. Larsen's Manufacturing Company;
    e. Modern Metal Products, Division of Technico Inc.;
    f. Moon-American;
    g. Potter Roemer LLC;
    h. Watrous Division, American Specialties, Inc.;

B. Cabinet Construction: Same rating as wall that it is inserted into.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick, fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Stainless-steel sheet.

1. Shelf: Same metal and finish as cabinet.

D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.

1. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.
2. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.

E. Cabinet Trim Material: Same material and finish as door.

F. Door Material: Stainless-steel sheet.

G. Door Style: Fully glazed panel with frame.

H. Door Glazing: Tempered float glass (clear).

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER"

1) Location: Applied to cabinet glazing.
2) Application Process: Silk-screened.
3) Lettering Color: Red.
4) Orientation: Vertical.

K. Finishes:
1. Stainless Steel: No. 6.

2.3 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
   1. Dull Satin Finish: No. 6.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

   1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
   2. Provide inside latch and lock for break-glass panels.
   3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes portable, fire extinguishers and mounting brackets for fire extinguishers.

B. Related Sections:

1. Division 10 Section "Fire Extinguisher Cabinets."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function.

C. Remaining paragraphs are defined in Division 01 Section "Submittal Procedures" as "Informational Submittals."Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

D. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FMG.

C. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:

a. Schedules and coordination requirements.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Amerex Corporation.
b. Ansul Incorporated; Tyco International Ltd.
c. Badger Fire Protection; a Kidde company.
d. Buckeye Fire Equipment Company.
e. Fire End & Croker Corporation.
f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
h. Larsen's Manufacturing Company.
i. Moon-American.
j. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
k. Potter Roemer LLC.
l. Pyro-Chem; Tyco Safety Products.

2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.

4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type in Steel Container UL-rated 2-A:10-B:C, 5-lb (2.3-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Amerex Corporation.
b. Ansul Incorporated; Tyco International Ltd.
c. Badger Fire Protection; a Kidde company.
d. Buckeye Fire Equipment Company.
e. Fire End & Croker Corporation.
f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
g. Larsen's Manufacturing Company.
h. Potter Roemer LLC.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 105113 – METAL LOCKERS

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes metal lockers and accessories.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Show filler panels for lockers and other accessories.
2. Include locker identification system.

C. Samples: For metal lockers, in manufacturer's standard sizes.

D. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in the Owner’s maintenance manuals.

E. Warranty: Warranty as specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of metal locker manufacturer for installation and maintenance of units required for this Project.

B. Source Limitations: Obtain metal lockers and accessories through one source from a single manufacturer.

C. Regulatory Requirements: Where metal lockers are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADA-AG)."

1. Provide hardware that does not require tight grasping, pinching, or twisting of the wrist, and that operates with a force of not more than 5 lbf (22.2 N).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for metal locker installation.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify the following by field measurements before fabrication and indicate measurements on Shop Drawings:

1. Concealed framing, blocking, and reinforcements that support metal lockers before they are enclosed.
2. Recessed openings.

1.7 COORDINATION

A. Coordinate size and location of bases for metal lockers.

B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.8 WARRANTY

A. Manufacturer's standard warranty form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures.
   b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for All-welded Metal Lockers: Lifetime from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below, before construction begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Full-size units of the following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than 5 units:

   a. Identification plates.
   b. Hooks.
   c. Door handle and latch assemblies.

PART 2 - PRODUCTS

2.1 METAL LOCKERS

A. All-Welded, Heavy-Duty Metal Lockers:

B. Design Basis Product: ASI Traditional Plus.

1. Arrangement: Double tier.
2. Material: Cold-rolled steel sheet.
3. Body and Shelves: 0.048-inch (1.21-mm) backs and 0.060-inch (1.52-mm) tops, bottoms, sides, and shelves.
4. Door Style: Solid, no louvers.
5. Hinges: Continuous.
6. Door Handle and Latch: Recessed, multipoint.
7. Locks: Padlock hasp for padlocks/combination locks furnished by the Owner.
8. Equipment: Hooks and coat rods.
9. Accessories: Filler panels.

C. Size: 12 inches wide by 18 inches deep by 36” high.

D. Finish: Powder coat in custom color as selected by the Architect.

E. Wood Base: Refer to Division 06 Section “Interior Architectural Woodwork.”

2.2 FABRICATION

A. Fabricate metal lockers square, rigid, and without warp; with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet, unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for a complete installation.

B. Unit Principle: Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. All-welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections, with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.

D. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.

E. Coat Rods: Fabricated from 3/4-inch- (19-mm-) diameter steel; chrome finished.

F. Identification Plates: Manufacturer's standard etched, embossed, or stamped aluminum plates; with numbers and letters at least 3/8 inch (9 mm) high.

G. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip joint filler angle formed to receive filler panel.

2.3 STEEL SHEET FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Factory finish steel surfaces and accessories except stainless steel and chrome-plated surfaces.

C. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.

D. Powdercoat Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting powdercoat finish in custom color as selected by the Architect. Comply with paint manufacturer's written instructions for application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion, using concealed fasteners.
2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
3. Anchor back-to-back metal lockers to floor.

B. All-welded Metal Lockers: Connect groups of all-welded metal lockers together with standard fasteners, with no exposed fasteners on face frames.

C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach hooks with at least two fasteners.
2. Attach door locks on doors using security-type fasteners.
3. Identification Plates: Identify metal lockers with identification indicated on Drawings. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.

4. Attach filler panels with concealed fasteners. Locate fillers panels where indicated on Drawings.

3.3 ADJUSTMENT, CLEANING, AND PROTECTION

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit metal locker use during construction.

C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal locker manufacturer.

END OF SECTION 105113

SECTION 105626 - HIGH DENSITY STORAGE SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

A. This Section includes manually-operated, laterally moving high density filing systems.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions for each type of shelving, track and installation accessory required. Submit written data on physical characteristics, durability, resistance to fading and flame resistance characteristics.

B. Shop Drawings: Submit shop drawings showing location, ranges and extent of high density storage shelving system. Show installation details.

C. Samples: Submit 6" square samples of each color and finish required. Prepare from same material to be used for the work.

D. Maintenance Data: For cleaning and maintaining storage units to include in the Owner’s maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Firm specializing in high density storage shelving system installation with experience installation of systems similar to those required for this Project within the immediate past 5 years.

B. Single Source Responsibility: Provide material produced by a single manufacturer for shelving, carriers and track.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with instructions and recommendations of manufacturer for special delivery, storage and handling requirements.

1.6 SEQUENCING AND SCHEDULING

A. Sequence storage shelving system installation with other work to minimize possibility of damage and soiling during construction period.

1.7 MAINTENANCE

A. Maintenance Instructions: Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use conditions. Include precautions against materials and methods which may be detrimental to finishes and performance.

B. Replacement Materials: After completion of work, deliver accessory components as required. Furnish replacement materials from same production run as materials installed. Package replacement materials with protective covering, identified with appropriate labels.

PART 2 - PRODUCTS

2.1 HIGH DENSITY STORAGE SYSTEM

A. Design Basis Product: qwikTRAK High Density Storage System for Super Erecta Wire Shelving as manufactured by InterMetro Industries Corp., Wilkes-Barre, PA. Components shall consist of the following:

1. Floor Track and Joining Channel: Surface-mounted, 6063 aluminum extrusion with 1/2" square stainless steel tubing. Joining channel shall be stainless steel.
2. Aluminum end plate and mounting plates for connecting post with foot plate to track.
3. Casters and Caster Horns: 3-1/4" acetyl wheel and stainless steel horns. Fixed end units shall not be equipped with casters.
4. Foot Plates and Hardware: Stainless steel.
5. Sizes of units shall be as indicated on the Drawings.

2.2 SHELVING

A. Design Basis Product: "Super Erecta Adjustable Shelf Wire Shelving" as manufactured by InterMetro Industries Corp., Wilkes-Barre, PA.

B. Provide the Design Basis manufacturer's components and accessories, as follows:

1. Corner Release System for repositioning shelves.
2. SiteSelect Posts with double-groove visual guides. Grooves shall be circular and located at 1-inch intervals and numbered at 2-inch intervals so as to identify desired shelf locations.
3. Tool-free adjustments to the shelving system may be made at 1" intervals along the entire height of posts.
4. Maximum Weight Capacity: 800 lbs., per shelf; 2,000 lbs., per stationary unit.
5. Accessories: Design Basis manufacturer's recommended accessories to suit applications.
6. Replacement Parts: Shelves, wedges, sleeves, shelf releases, without limitation.
7. Provide units in Design Basis manufacturer's Type 304 stainless steel chrome plated finishes as specified herein.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, floor conditions, positioning of exits and aisleways and overall dimensions of space and other construction elements affecting installation of Work of this Section.

B. Proceed with installation only after unsatisfactory conditions have been corrected. Start of Work shall indicate acceptability of related work.

3.2 PREPARATION

A. Prior to installation of shelving system, vacuum floor surface to remove dust, debris and loose particles. Verify that components, including size and finish are those specified before installing.

3.3 INSTALLATION

A. Install shelving system and accessories after finishing operations, including painting have been completed. Install system to comply with final layout drawings, in strict compliance with manufacturers printed instructions. Position units level, plumb; at proper location relative to adjoining units and related work.

3.4 FIELD QUALITY CONTROL

A. Remove and replace components which are chipped, scratched, or otherwise damaged and which do not match adjoining work. Provide new matching units, installed as specified and in manner to eliminate evidence of replacement.

B. Demonstration: Upon completion of installation of system, test to demonstrate capability and compliance with requirements. Repair or replace units which do not operate smoothly.

3.5 ADJUSTMENT AND CLEANING

A. Adjust components and accessories to provide smoothly operating, visually acceptable installation.

B. Immediately upon completion of installation, clean components and surfaces.

C. Remove surplus materials, rubbish and debris resulting from installation upon completion of work and leave areas of installation in neat, clean condition.

3.6 PROTECTION

A. Protect system against damage during remainder of construction period. Advise owner of additional protection needed to ensure that system will be without damage or deterioration at time of substantial completion.

END OF SECTION 105626

SECTION 115213 - PROJECTION SCREENS

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes electrically-operated front-projection screens.

B. Related Sections include the following:

1. Division 26 Electrical Specification Sections for electrical service and connections including metal device boxes for switches and conduit, where required, for low-voltage control wiring.

1.3 DEFINITIONS

A. Gain of Front-Projection Screens: Ratio of light reflected from screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94.

1.4 SUBMITTALS

A. Product Data: For each type of screen indicated.

B. Shop Drawings: Show layouts and types of projection screens. Include the following:

1. Location of wiring connections.
2. Drop length.
3. Connections to supporting structure for pendant- and recess-mounted screens.
4. Anchorage details.
5. Details of juncture of exposed surfaces with adjacent finishes.
6. Accessories.
7. Wiring diagrams.

C. Maintenance Data: For projection screens to include in the Owner’s maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain projection screens through one source from a single manufacturer. Obtain each screen as a complete unit, including necessary mounting hardware and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed and other construction within spaces where screens will be installed is substantially complete and ready for screen installation.

1.7 COORDINATION

A. Coordinate layout and installation of projection screens with adjacent construction, including ceiling framing, light fixtures, HVAC equipment, fire-suppression system, and partitions.

PART 2 - PRODUCTS

2.1 FRONT-PROJECTION SCREENS

A. Electrically Operated Screens, General: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Line Voltage Control: Remote, key-operated, 3-position control switch installed in recessed metal device box with flush cover plate matching other electrical device cover plates in room where switch is installed.
2. Motor in Roller: Instant-reversing motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.
3. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch- diameter metal rod with ends of rod protected by plastic caps.

    a. Roller for motor in roller supported by vibration- and noise-absorbing supports.

B. Recessed, Electrically Operated Screens with Automatic Ceiling Closure: Motor in roller units designed and fabricated for recessed installation in ceiling; with bottom of case composed of two panels fully enclosing screen, motor, and wiring, one panel hinged and designed to open and close automatically when screen is lowered and fully raised, the other removable or openable for access to interior of case.
1. Provide metal or metal-lined wiring compartment on units with motor in roller.
2. Screen Case: Made from metal, wood, wood products, and fire-retardant materials.
3. Provide screen case constructed to be installed with underside flush with ceiling.
4. Prime paint surfaces of screen case that will be exposed to view in the finished work.

C. Screen Material and Viewing Surface:

1. Matte-White Viewing Surface: Peak gain of 0.9 to 1.0, and gain of not less than 0.8 at an angle of 50 degrees from the axis of the screen surface.
2. Material: Vinyl-coated glass-fiber fabric.
3. Mildew Resistance: Rating of 0 or 1 when tested according to ASTM G 21.

4. Flame-Spread Index: Not greater than 75 when tested according to ASTM E 84.
5. Seamless Construction: Provide screens, in sizes indicated, without seams.
6. Edge Treatment: Without black masking borders.
7. Size of Viewing Surface: Minimum 72 by 72 inches, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Determine that related work is not detrimental to the timely completion of the Work of this Section. Start of Work shall indicate acceptability of related work.

3.2 INSTALLATION

A. Install projection screens at locations indicated to comply with screen manufacturer's written instructions and approved Shop Drawings.

B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.

1. Test electrically operated units to verify that screen controls, limit switches, closure, and other operating components are in optimum functioning condition.

C. Instruct the Owner’s personnel with regard to operating and maintenance instructions.

3.3 PROTECTION AND CLEANING

A. After installation, protect projection screens from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION 115213

SECTION 122413 – ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes manually-operated roller window shades.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.

B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments and relationship to adjoining Work, and operational clearances.

C. Samples:

1. Complete, full-size operating unit not less than wide for each type of roller shade indicated.
2. Shade Material: Not less than 12 inches square, with specified treatments applied. Mark face of material.

D. Maintenance Data: For roller shades to include in the Owner's maintenance manuals. Include the following:

1. Methods for maintaining roller shades and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
3. Operating hardware.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed installation of roller shades similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance during the immediate past 5 years.

B. Source Limitations: Obtain roller shades through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Resistance Ratings: Passes NFPA 701.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Coverings Schedule.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Rollers Shades: Before installation begins, for each size, color, texture, and pattern indicated, full-size units equal to 5 percent of amount installed.

PART 2 - PRODUCTS

2.1 ROLLER WINDOW SHADES

A. Design Basis Product: Mecho 5 #1550 Ecoveil by MechoShade Systems.

1. Fabric: Ecoveil Screens fabric, 100 percent thermoplastic polyolefin, cradle-to-cradle certified by GreenGuard, single thickness, non-raveling 0.030 inch thick fabric, 3 percent openness factor, 100” wide, passes NFPA 701.
2. Fabric shall be PVC-free, waterproof, washable, fungal- and bacterial-resistant.
3. Colors: As selected by the Architect from the manufacturer’s full range.

B. Accessories: Aluminum front/reverse roll shade fascia, concealed mounting hardware, total side and bottom channels.

C. Mounting: Inside jamb, unless otherwise indicated.

D. Operation: Manual chain operation.

E. Pocket: The manufacturer’s vented (or return) pocket.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions and approved Shop Drawings, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware. The darker side of roller shades and blackout shades should face the exterior.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. A.Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.

END OF SECTION 122413

SECTION 123553 – DENTAL LABORATORY CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK

A. Work of this Section includes providing and installing stock and custom metal and steel laboratory casework units, complete with laboratory countertops, integral sinks, fittings, and accessories. Include fillers, scribes, access holes for mechanical, electrical and HVAC work.

B. Refer to Division 06 Section “Interior Architectural Woodwork” for solid surface countertops.

1.3 SUBMITTALS

A. Product data for each type of laboratory furniture unit specified.
   1. Include independent laboratory certification that applied finish complies with specified chemical and physical resistance requirements.

B. Shop drawings for laboratory casework and fittings showing plan layout, elevations, ends, cross-sections, service run spaces, location of service fittings, together with associated service supply provisions required.
   1. Include details and location of anchorages and fitting to floors, walls, and base, including required blocking or back-blocking.
   2. Include layout of units with relation to surrounding walls, doors, windows, and other building components.
   3. Coordinate shop drawings with other work involved.

C. Samples for verification purposes of each type of specified finish, including top material. Provide in minimum 6-inch by 6-inch sizes. Samples will be reviewed by Architect for color, texture, and pattern only. Compliance with other specified requirements is exclusive responsibility of Contractor.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: Provide laboratory casework with tops, backsplashes, sinks, and accessories manufactured or furnished by same laboratory furniture company for single responsibility.
   1. Manufacturer’s qualifications: Modern plant with proper tools, dies, fixtures, and skilled workmen to produce high quality laboratory casework and equipment, and shall meet the following minimum requirements:
      a. Minimum of ten years experience in manufacture of laboratory casework.
      b. Ten installations of equal or larger size.
   2. Installer’s qualifications: Factory certified by the manufacturer.
   3. Manufacturer to provide load test results by outside testing organization for drawers, suspension slides, and unit shelving.

B. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Conference shall occur after all utilities have been roughed-in, wall finishes have been installed and exterior window systems have been installed at one room but prior to casework installation. A layout of the installed casework shall be marked on the floor and walls for coordination with other trades and suppliers.

C. Warranty: Provide manufacturer's two year warranty against defects in materials and workmanship. Subject to provisions of the warranty, manufacturer agrees to repair or replace non-conforming products or its parts for the warranty period following substantial completion. Drawer suspension to have a limited lifetime warranty. (See Casework Fabrication for details.)

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver laboratory casework only after wet operations in building are completed.

B. Store completed laboratory casework in a ventilated place, protected from the weather, with relative humidity of 50 percent or less at 70 deg F (22 deg C).

C. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with polyethylene film or other protective covering.

1.6 EXTRA MATERIALS

A. Furnish complete touch-up kit for color of laboratory casework provided. Kit to include touch-up paint and other materials necessary to perform permanent spot repairs to damaged casework finish.

PART 2 - PRODUCTS

2.1 METAL LABORATORY CASEWORK:

A. Manufacturers: Subject to compliance with requirements manufacturers offering steel laboratory casework products may be included by the following:
1. Nevin Laboratories Inc. Design Basis:
2. Kavo Equipment.

B. General: Provide exposed portions of steel laboratory casework with factory finish that provides for abrasion and chemical resistance for service in laboratory environment.

C. Exposed Materials: Sheet steel cold-rolled furniture stock.

1. Stainless Steel Sheet: ASTM A 240, Type 304.
2. All members die-formed, notched, assembled in fixtures; exposed welds polished smooth; face corner intersections of vertical and horizontal members in same plane, with joints welded and polished; doors and drawer heads in same plane.
3. Gauges:
   a. Drawer bodies and heads, shelves, interior door panels, security panels, and sloping tops - 20 gauge.
   b. Ends, backs, case tops and bottoms, bases, exterior door panels and vertical posts - 18 gauge.
   c. Top front and intermediate rails, gussets, table legs, frames, leg rails and stretchers - 16 gauge.
   d. Drawer suspensions, door and case hinge reinforcements, and L-shaped front corner gussets - 14 gauge.
   e. Table leg corner brackets and leveler gussets - 11 gauge.
4. Base cabinets, cupboards to open full width; center support posts not acceptable.

a. End panels and back, formed of one-piece, wraparound design; rear internal reinforcing channel with shelf-clip adjustment holes; front post to provide for rails, runs, hinges, and shelf clips; toe base structurally integral to cabinet body.
b. Top front rail to interlock and overlap end panels with rabbeted offset for dust resistance.
c. Horizontal intermediate cross rails required for locks, recessed and concealed.
d. All floor-mounted cabinets supported on four leveling screws adjustable from access in toe base; cupboard back access panels, when selected, removable with simple tools.
e. Drawer bodies of welded construction with cove at bottom sides and flanged at topsides for hand grip; suspension and rounded raceways and radiused, nylon-tired, ball-bearing rollers for self-centering operation; suspension to lock open, with automatic close last five inches; cushioned stop, in and out; drawer heads finished on all surfaces before assembly; sound-deadening material in head; friction centering springs not acceptable.
f. Bottoms of solid-panel, one-piece construction, front-formed for door and drawer dust resistance; holes or capped punch-outs for leveling screw access not acceptable.

5. Hardware:
a. Base molding, 4" high, black rubber or vinyl
b. Leg shoes, black rubber or vinyl with provisions for floor clip.
c. Hinges, 2-1/2", 5 knuckle, stainless steel, screw attachment; welded hinges not acceptable.
d. Friction catches, nylon-roller type, adjustable, with strike.
e. Elbow catch, spring-type, with strike.
f. Locks, 5-disc tumbler, heavy-duty cylinder type; dull nickel- (satin) plated, stamped with identifying number.

2.2 LABORATORY CASEWORK HARDWARE AND ACCESSORIES

A. Hardware, General: Provide manufacturer's standard satin finish, commercial quality, heavy-duty hardware complying with requirements indicated for each type.

B. Hinges: Institutional 5-knuckle hinges. Provide one pair for doors less than 4 feet high and 1-1/2 pair for doors over 4 feet high.

C. Pulls: Solid metal for drawers and swing doors, mounted with 2 screws fastened from back. For sliding doors, provide recessed flush pulls. Provide 2 pulls for drawers over 24 inches wide.

D. Door Catches: Nylon-roller spring catch or dual self-aligning, permanent magnet catch. Provide 2 catches on doors over 4 feet high.

E. Drawer Guides: Provide nylon-tired, ball-bearing rollers with metal guide channels and integral stops to eliminate accidental removal of drawer. Provide guides designed to provide self-closing of drawer and to prevent rebounding action when drawers are closed.

F. Drawer Stops: Designed to permit easy removal, and yet prevent inadvertent drawer removal. Provide on all drawers, located on the inside.

G. Filler Strips: Provide where required for closing space between cabinets and walls and ceilings, of same material and finish as cabinets.

H. Drawer and Cupboard Locks: Half-mortise type, 5-pin tumbler and dead bolt, round cylinder only exposed, brass with plated finish. Grand master keying for each use area.

I. Sliding Door Hardware Sets: Manufacturer's standard, to suit type and size of sliding door units.

J. Cabinet Base Molding: Extruded vinyl or rubber, black, 4 inches high. Provide on exposed sides and fronts of floor-mounted cabinets.

K. Adjustable Shelf Supports: Provide standard pin and socket shelf supports of 1¼ inch centers.

2.3 STAINLESS STEEL LABORATORY CASEWORK HARDWARE

A. Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.

B. Hinges: Stainless steel, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 for doors 48 inches (1200 mm) high or less and 3 for doors more than 48 inches (1200 mm) high.

C. Hinged Door and Drawer Pulls: Stainless steel back-mounted pulls. Provide 2 pulls for drawers more than 24 inches (600 mm) wide.

D. Door Catches: Dual, self-aligning, permanent magnet catches. Provide 2 catches on doors more than 48 inches (1200 mm) high.

E. Drawer Slides: Side mounted, epoxy-coated steel, self-closing; designed to prevent rebound when drawers are closed; complying with BHMA A156.9, Type B05091.

1. Provide Grade 1HD-100; for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.
2. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Full-extension, ball-bearing type.

2.4 TOPS, SINKS, AND ACCESSORIES

A. Tops, Box Curbs, Backsplash Assemblies, Splash Rim Offsets and Drops: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Make exposed edges and corners uniformly rounded.

B. Top Thickness: 1-inch thickness, with tolerance not exceeding plus or minus 1/32 inch. Provide front and end overhang of 1 inch over base cabinets, formed with continuous drip groove on under surface 1/2 inch from edge.

C. Stainless Steel Countertops/Sinks: Design Basis products shall be Work Stations as manufactured by Getinge USA, Inc., Models 6761 and 6762, Single- and Double-sink Modules, respectively. Comparable products by other reputable manufacturers will be considered.

1. Construction, General: Welded, stainless steel construction consisting of a countertop with integral sink and fixtures, and understructure consisting of a shelf, apron, and legs.
2. Countertops: Constructed of 16 gauge, Type 304 stainless steel, satin finish. Countertop shall be reinforced with steel channels and covered with a sound-deadening undercoating. A 4” high backsplash will be included. The front edge and sides of the countertop shall include a raised 1/8” drain bead for retaining water spillage.
3. Sink Bowl: Constructed of a formed, seamless type construction with internal corners rounded to a 1” radius. Formed construction shall ensure a uniform side wall thickness. The sink bottom shall be pitched slightly to ensure positive drainage. A strainer and tail piece will be provided with the sink. The sink shall be welded into the countertop and ground smooth to achieve a continuous, seamless construction and watertight joints.
   a. Nominal Size: 24” long x 17” wide x 10” deep, unless otherwise indicated.

4. Understructure: Apron, legs, and shelves of the understructure shall be constructed of 18 gauge stainless steel. The apron shall be approximately 11" high. The legs shall be tubular, 1-5/8" O.D., with stainless steel bullet-type leg adjustments.
5. Sink Fixtures: T&S Brass Model 1152 deck-mounted, hot and cold water mixing faucet shall be included weith 8" rigid swing nozzle and 48" stainless steel hose with spray valve. The assembly shall be capable of using water up to 180 degrees F at 30 psi water pressure, minimum.

D. Stainless Steel Wall Shelves: NSF approved, stainless steel Type 300, #3 polish, satin finish, 16 gauge. Shelf shall have a finished, safety stallion front edge and a 1-1/2" turned up backsplash, 16" wide by 36" long, stainless steel support brackets to match shelf. Exposed welds shall be polished to match adjacent surface. Dimensions as indicated on the Drawings. Design Basis manufacturer is John Boos & Co., Effingham, IL.

2.5 SINKS, TROUGHS & DRAIN BOARDS

A. Sizes: As indicated on the Drawings, or manufacturer's closest stock size of equal or greater volume, as acceptable to Architect.

B. Outlets: 1-½-inch diameter, 6-inch minimum length, fabricated of silicon iron, stainless steel, glass, or lead; of same material as sink wherever possible, or as otherwise acceptable to Architect.

C. Install sink units to tops with integral rim or sink ring, set in mastic or sealant to form a positive seal with top. Apply approximately 1/8-inch-thick, heat-resistant underseal to undersink surfaces for condensation prevention and sound-deadening.

2.6 MECHANICAL SERVICE FITTINGS SCHEDULE

A. Outlets: Provided by and installed by this section
1. Faucets and Related Accessories at rooms containing laboratory casework provided by this section. Basis of design shall be Thermo Scientific Deck Mounted Rigid Gooseneck with Wrist Blade Handles and Aerator, product number 33L46200. If required, provide foot controls.

B. Outlets: Provided by and installed by Division 22
1. Natural Gas Outlet
2. Air Outlet
3. Vacuum Outlet
4. Water Outlet
5. Compressed Air Outlet

2.7 ELECTRICAL SERVICE FITTINGS

A. Service Fittings: Refer to Division 26 for building installed electrical service fittings.

B. Service Fittings provided and installed by this section for modular bench units indicated on the drawings.
1. Electrical Outlets
2. Data Outlets
3. Plug Mold Strips
4. Task light Assemblies

PART 3 - EXECUTION

3.1 CASEWORK

A. Install plumb, level, true and aligned with no distortions. Shim as required, using concealed shims. Where laboratory casework abuts other finished work, scribe and apply filler strips for accurate fit with fasteners concealed where practicable.

B. Base Cabinets: Set cabinets straight, plumb, and level. Adjust sub-tops within 1/16 inch of a single plane. Fasten each individual cabinet to floor at toe space with fasteners spaced 24 inches on center. Bolt continuous cabinets together. Secure individual cabinets with not less than 2 fasteners into floor where they do not adjoin other cabinets.
   1. Where required, assemble units into one integral unit with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.

C. Wall Cabinets: Securely fasten to solid supporting material and not to plaster, lath, or wallboard. Anchor, adjust, and align wall cabinets as specified for base cabinets.
   1. Reinforcement of stud walls to support wall-mounted cabinets will be accomplished during wall erection by trade involved; however, indicating accurate location and sizing of reinforcement is responsibility of laboratory casework Installer.

D. Install hardware uniformly and precisely after final finishing is complete. Set hinges snug and flat in mortises unless otherwise indicated. Turn screws to flat seat. Adjust and align hardware so that moving parts operate freely and contact points meet accurately. Allow for final field adjustment after installation.

E. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.2 TOPS

A. Field Jointing: Where practicable, make in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Locate field joints as shown on accepted shop drawings, factory-prepared so there is no jobsite processing of to and edge surfaces.

B. Fastenings: Use concealed clamping devices for field joints located within 6 inches of front, at back edges, and at intervals not exceeding 24 inches. Tighten in accordance with manufacturer's instructions to exert a constant, heavy clamping pressure at joints.

C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent any deflection. Provide flush hairline joints in top units using clamping devices. At stone-type material joints, use manufacturer's recommended adhesives and holding devices to provide joint widths not more than 1/16 inch wide at any location, completely filled and flush with abutting edges.
   1. Where necessary to penetrate tops with fasteners, countersink heads and plug hole to be flush with adjacent surfaces. Material shall be equal in chemical resistance, color, hardness, and texture to top surface.

D. Provide holes and cutouts as required for mechanical and electrical service fittings, and for Owner's equipment vendor supplied items to be mounted to countertops.

E. Carefully dress joints smooth, remove any surface scratches, clean and polish entire surface.

F. Provide scribe moldings for closures at junctures of top, curb, and splash with walls as recommended by manufacturer for materials involved. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

3.3 SINKS

A. Underside Installation: Use manufacturer's recommended adjustable support system for table-type and cabinet-type installations.

B. Set top edge of sink unit in manufacturer's recommended chemical-resistant sealing compound and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement.

C. Semiflush Installation: Use stainless steel sink frame, complete with clamping lugs and pads. Before setting, apply a full coat of manufacturer's recommended sealant under rim lip and along top. Omit sink frame if sink fabricated with integral rim seal.

3.4 ACCESSORIES

A. Install accessories in accordance with approved location drawings and manufacturer's installation recommendations. Turn screws to a flat seat; do not drive. Adjust moving parts to operate freely and smoothly without binding.

3.5 CLEANING AND PROTECTION

A. Repair or remove and replace defective work as directed upon completion of installation.

B. Clean factory- and shop-finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as acceptable to Architect.

C. Protection: Provide 6-mil plastic or other suitable water-resistant covering over counter top surfaces. Tape to underside of counter top at minimum of 4 feet on center. Advise Contractor of procedures and precautions for subsequent protection of installed laboratory casework and fittings from damage by work of other trades.

END OF SECTION 123553

SECTION 14240

HYDRAULIC ELEVATOR

1. GENERAL:

1.1 REFERENCES: Drawings and general provisions of Contract, including General Conditions and Division 1 specifications, apply to work in this section.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. 110 volt branch circuit to the terminals of the elevator controller for car light supply and 110 volt light and outlet in the elevator pit, complete with switch adjacent to the pit ladder as shown on Elevator Drawings.

B. Any cutting, patching or painting of walls and grouting under thresh-holds and hoistway frames.

C. Adequate supports for guide rail brackets.

D. Sill support angles.

E. Electrical current during erection and testing of equipment. 3 phase fused disconnect, & 110 volt fused disconnect

F. Necessary recesses to accommodate doors, sills, (min. 2-1/2" deep) and signal equipment such as indicators, push buttons, hall lanterns, etc.

G. Pit access ladder.

H. General Contractor to receive, handle and store in the building approximately ten (10) tons of elevator materials.

I. Smoke sensors in each elevator lobby and elevator machine room complete with necessary wiring to elevator controller. A shunt trip circuit breaker with heat detectors will also be provided as required.

J. 1-Dedicated phone. (If additional phone lines are required by elevator manufacturer they will be paid for by elevator contractor including monthly charges)

1.3 REGULATORY AGENCIES: Perform all work in accordance with the National Electrical Code, American Standard Safety Code and such state and local codes as may be applicable.

1.4 SUBMITTALS: Shop Drawings-

A. Submit six (6) blue print copies of elevator layout drawings to the Architect for approval.

B. Upon completion submit to Owner, warranty operating manual and maintenance information.

1.5 GUARANTEE:

A. Elevator Contractor shall guarantee that materials and workmanship of apparatus installed by him under these Specifications shall be first class in every respect; and that he will make good any defects not due to ordinary wear and tear or improper use which may develop within one (1) year from date of completion and installation.

B. In addition to the other requirements, inspection, tests and remedies herein provided upon completion of elevator installation and before final approval and final payment, Elevator Contractor shall make, in speed test with full maximum load on elevator to determine whether elevator equipment as installed meets the speed, capacity and all other requirements of the Specifications.

C. In event equipment does not meet all requirements of Specifications, Elevator Contractor shall promptly remove from the premises all work condemned by Architect as failing to conform to the contract and shall bear all expense of making good all work of other Contractors destroyed or damaged by such removal or replacement. If Elevator Contractor does not remedy such condemned work within a reasonable time, fixed by written notice from Architect, General Contractor may correct such condemned work at expense of Elevator Contractor and withhold such cost from final payment under contract price. In the event the remainder due under Contract price is insufficient to cover such a cost, Elevator Contractor shall, immediately upon request, reimburse General Contractor in full.

1.6 PERMITS, TAXES AND LICENSES: All permits, inspection fees and licenses necessary for the execution of the work shall be secured and paid for by the Elevator Contractor.

1.7 TEMPORARY USE: The General Contractor, Sub-contractors, Owner or others will not be permitted use of the elevators during construction except under a written agreement as stipulated by the Elevator Contractor.

2. PRODUCTS:

2.1 ACCEPTABLE MANUFACTURES:

A. Except as otherwise specified herein, or specifically approved by Architect, the Elevator Contractor shall be regularly engaged in installation of elevators of type specified herein, and shall be able to demonstrate at least three (3) installations of this

type made by him within the State of Maine which have provided satisfactory operation for a period of five (5) years prior to the date of receipt of General Bids, for this project.

B. Demonstrate that he has provided satisfactory maintenance service for elevators of type specified and that he has maintained a complete maintenance organization comprised of regularly employed inspectors and mechanics within the State of ME for a period of at least five (5) years prior to the date of receipt of General Bids.

C. Provide 1 year maintenance warrantee for ensuring reliable operation of elevator, and make available complete ongoing maintenance service package.

D. Elevator shall be equal to Canton Elevator Company, or approved equal. Elevator shall meet latest ANSI handicapped requirements and Maine State Elevator Code. Request for substitutions shall be received in writing 10 days prior to bid date and shall include contact information for at least 2 additional local companies capable of providing full maintenance type service on the unit after initial warranty period,

E. Delivery of elevator systems shall be guaranteed by Manufacturer to be on site sixteen (16) weeks after receipt of approved Shop Drawings. Shop Drawings shall be submitted to the General Contractor for review by the Architect within ten (10) days of Sub-Contractors award.

2.2 MATERIALS AND FABRICATIONS:

A. Description of equipment –

Quantity –	2 -Hydraulic
Capacity:	#1-2500 lbs.; #2 2500 lbs
Speed:	90 fpm
Operation:	Simplex sellective collective –confirm with owner
Travel:	as shown on Drawings
Type:	Holed hydraulic or holeless direct acting hydraulic
Power supply:	208 v 3 phase, 60 cycle.
Machine Location:	As shown on Drawings (remote)
Stops & Openings:	#1-2 stops inline, #2-3 stops inline

Car Enclosure:	High pressure laminate interior panels, overhead fluorescent lighting above egg acrylic suspended ceiling, stainless steel returns, and stainless steel car doors. Handrail on rear. Carpeted floor by others. One (1) set Protection pads and hooks per car Include: ADA compliant telephone Fan Emergency Lighting Proximity detectors, door protection
Hoistway Door Frames:	Hollow metal U.L. "B: labeled door, square frame
Door Size & Type:	3'-6" W x 7'-0"H; - (clear opening) finish to be baked enamel; color to be selected from standard selection charts
Door Operation:	D.C. Power Operation
Signals:	Illuminated halo buttons, (Braille) alarm bell, in car location. Hall position indicator at main floor level. In – Car Direction Lantern
Special Features:	Special handicap provisions Door Hold Key Service Independent Operation Key Switch Card reader provision
Motor HP:	3 Phase Power 25 HP Max
Starter	Solid state soft start

B. Jack unit:

1. The jack unit shall be designed and constructed in accordance with the applicable requirements of the American Standard Safety Code for Elevators A-17. It shall be of sufficient size to lift the gross load the height specified. It shall be factory tested to insure adequate strength and freedom for leakage. No brittle material, such as gray cast iron, shall be used in the jack construction.

2. The jack unit shall consist of the following parts: a plunger of heavy polished steel tubing accurately turned; a stop ring shall be electrically welded to the plunger to positively prevent plunger leaking its casing made of steel tubing and provided with a pipe connection and air bleeder; Brackets shall be welded to jack casing and supporting the elevator on pit channels.

3. A PVC cylinder protection system shall be installed. Union Guard corrosion protection to fill void no exceptions.

4. A standard wellhole with steel pipe casing to retain the hole shall be provided**.** All drilling spoils are to be removed by the general contractor. Water for drilling, if required, will be provided by others also. Should obstructions such as boulders, debris, water, quicksand or any other condition other than normal soil, clay or standard ledge be encountered, additional time to drill the hole will be treated as a change order. Work to cease until a change order is issued.

C. Car:

1. Platform and Sling: The platform and sling have a fabricated frame of formed and structural steel shapes, gusseted and rigidly welded. Flooring shall be wood top floor laid over wood sub-floor. Finished flooring shall be provided, by others, on top of the car platform.

2. The sling shall consist of heavy steel channel stiles properly affixed to a steel cross head and bolster, with adequate bracing members, to remove all strain from the car enclosure.

3. Steel bumper plates shall be affixed to bottom of bolster channels; and a platen plate with clamps and car screws shall be furnished for fastening sling to plunger.

D. Car doors: The car entrance shall be provided with horizontal sliding doors. Panel rigidity to be obtained by suitable steel reinforcements. Doors shall be hung on sheave hangers with polyurethane tires and sheaves not less than 2-1/2" diameter running on a polished steel track, and guided at the bottom by non-metallic shoes sliding in a smooth threshold groove.

E. Alarm bell: An emergency alarm bell shall be located in conformance with ANSI A-17 Code requirements, and connected to a plainly marked push button in the car. Alarm bell shall be connected to the emergency lighting power pack.

F. Guide and Guide Shoes: Guides for the elevator car shall be planed steel elevator guide rails, properly fastened to the building structure with steel brackets. The car stile shall be fitted at top and bottom with sliding guide shoes.

G. Power Unit:

1. (Oil pumping and control mechanism) shall be compactly and neatly designed with all of the components listed below combined in a self-contained unit; structural steel outer base with tank supports; floating inner base for mounting motor pump assembly; over head oil reservoir with tank cover and controller compartment with cover; metal drip pan; oil-hydraulic pump; electric motor; and oil control unit with the following components built into a single housing: a high pressure relief valve, a check valve, an automatic unloading up start valve, a lowering and leveling valve, and a magnetic controller, or a self contained submersible of manufactures standard type.

2. The pump shall be especially designed and manufactured for oil-hydraulic elevator service. It shall be of positive displacement screw type, inherently designed for steady discharge with minimum pulsations to give smooth and quiet operation. Output of pump shall not vary more than ten percent (10%) between no load and full load on elevator car.

3. Motor shall be especially designed for oil-hydraulic elevator service, of standard manufacturer and of duty rating to comply with specified speeds and loads.

4. Oil control unit shall consist of the following components, all built into a single housing. Welded manifolds with separate valves to accomplish each function will not be acceptable under this Specification. All adjustments shall be accessible and shall be made without removing the assembly from the oil lines:

    a. Relief valve shall be externally adjustable and shall be capable of bypassing the total oil flow without increasing back pressure more than ten percent (10%) above that required to barely open the valve.

    b. Up start and stop valve shall be externally adjustable, and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, insuring smooth up starts and up stops.

    c. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.

    d. Lowering valve and leveling valve shall be externally adjustable for drop-away speed, lowering speed, leveling speed and stopping speed to insure smooth "Down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling when slow down is initiated.

5. Electric controller shall be of the full magnetic type or solid-state integrated circuitry. Silver to silver contacts shall be utilized on all relays and contractors. Thermal overload relays to be provided to protect the motor. All component

switches to be mounted in a steel panel designed for wall to floor mounting. Shall have built in diagnostics, no proprietary tools required to service unit.

H. Mainline Strainer: A mainline strainer of the self-cleaning type, equipped with a 40-mesh element shall be furnished and installed in the oil line.

I. Failure Protection: The electrical control circuit shall be designed so that if a malfunction should occur, due to motor starter failure, oil becoming low in the system, or the car failing to reach a landing in the up direction within a predetermined time, the elevator car will automatically descend to the lowest terminal landing. If power operated doors are used, the doors will automatically open when the car reaches the landing to allow passengers to depart. The doors will then automatically close and all control buttons, except the "door open" button in the car station, shall be made inoperative.

J. Sound Isolating Coupling: Install a minimum of one in the oil line in the machine room between pump and jack

K. Oil-Hydraulic Silencer (muffler device): Install in oil line near power unit. It shall contain pulsation-absorbing material inserted in a blowout-proof housing arranged for inspecting interior parts without removing unit from oil line. Rubber hose without blowout-proof features will not be acceptable.

L. Vibration Pads: Mount under the power unit assembly to isolate the unit from the building structure.

M. Automatic Terminal Limits: Place electric limit switches in the hatchway near the terminal landing; designed to cut off the electric current and stop the car should it run beyond either terminal landing.

N. Automatic Self-leveling: Provide elevator with a self-leveling feature that will automatically bring the car to the floor landings. This self-leveling shall, within its zone, be entirely automatic and independent of the operating device, and shall correct for over travel or under travel. The car shall also be maintained approximately level with the landing regardless of the load.

O. Buffers: Furnish and install substantial buffers under the car in the elevator pit. They shall be mounted on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor and substantial extensions will be provided, if required. Buffers shall comply with ANSI A-17.1 Code requirements.

P. Car Top Inspection Station: A car top inspection station with an "emergency stop" switch and with constant pressure "up-down" direction buttons shall make the normal operating devices inoperative and give the inspector complete control of the elevator.

Q. Door Operation: Furnish and install a direct current motor driven heavy-duty operator designed to operate the car and hoistway doors simultaneously. Door movements shall be electrically cushioned at both limits of travel and door-operating mechanism shall be arranged for manual operation in event of power failure. The leading edge of the car door shall be provided with a retractable reversal edge arranged to automatically return car and hoistway doors to the open position in the event the doors are obstructed during closing cycle. Doors will then resume closing cycle.

Doors shall automatically open as the car arrives at the landing and shall automatically close after an adjustable time interval or when the car is dispatched to another landing. Direct drive geared operators, A.C. controlled units with oil checks, or other deviations for the above are not acceptable.

R. Interlock: Equip each hoistway entrance with an approved type interlock tested as required by Code. The interlock shall be designed to prevent operation of the car away from the landing until the doors are locked in the closed position as defined by Code and shall prevent opening the doors at any landing from the corridor side unless the car is at rest at the landing or is in the leveling zone and stopping at the landing. Interlocks shall bear Underwriter's Laboratories "B" label of approval.

S. Hoistway Door Unlocking Device: Provide hoistway door unlocking devices as specified by the ANSI A-17.1 Code to permit authorized persons to gain access to hoistway when elevator car is away from the landing.

T. Door Hangers and Tracks: For each hoistway sliding door, furnish and install sheave type two point suspension hangers and tracks complete. Sheaves shall be 2-1/2" in diameter and have polyurethane tires with ball bearings properly sealed to retain grease. Hangers shall be provided with an adjustable slide to take the up-thrust of the doors. Tracks are to be drawn steel shapes, smooth surface and shaped to conform to the hanger sleeves.

U. Hoistway Entrances: Hoistway entrances of the hollow metal, horizontal sliding type shall be furnished and installed complete at each of the hoistway openings. Note that entrances must be at least minimum legal width for wheelchair use, meeting ANSI A-17.1.

1. Entrances shall be manufacturer's standard design and shall bear Underwriter's Laboratories "B" labels. They shall consist of frames, sills, doors, hangers, hanger supports, hanger covers, fascia plates, and all necessary hardware. Finish to be baked on enamel chosen from manufacturer’s standard.

2. The entire front wall of the hoistway is to be left open or a rough opening provided which is 12" greater in width and 6" greater in height than the finished opening, until after entrances are installed. After guide rails are set and lined, the entrance

frames shall be installed in perfect alignment with the guide rails. Finish walls will then be completed by others.

V. ADA telephone shall be furnished with wiring from elevator cab to the machine room and telephone box. Wiring to be coordinated with Electrical Contractor and tied into outside phone system.

W. Operation (Selective Collective Automatic Push-button): Control of the elevator car shall be automatic in operation by means of a push-button in the car marked for each of the landing levels served and an "up-down" button at each intermediate landing with a call button at each terminal landing, wherein all stops registered by the momentary pressure of landing or car buttons shall be maintained until the car answers the call. An emergency stop switch shall be provided in the car push-button station which, when in the off position, will render the elevator inoperative, and which will enable attendant or passenger to stop the car at any point during its travel. Opening of this switch shall not cancel registered calls, and when the switch is closed the car will continue to answer calls that have been registered. Each landing station shall contain an illuminated push-button which shall "light-up" when pressed to indicate that a call has been registered to bring the car to that particular landing. A time delay non-interference feature shall be incorporated in the control mechanism to allow simple time for opening and closing car and hoistway doors before it is again placed in motion.

X. Special Emergency Service:

1. Special Emergency Service Operation shall be provided in compliance with the latest revision of the ASME/ANSI A17.1 or CAN3-B44 Code.

2. Special Emergency Service Phase I to return the elevator non-stop to a designated floor shall be initiated by an elevator smoke detector system or a keyswitch provided in a lobby fixture.

3. The smoke detector system is to be furnished by others. The elevator contractor shall provide contacts on the elevator controller to receive signals from the smoke detector system.

4. A keyswitch in the car shall be provided for in-car control of each elevator when on Phase II of Special Emergency Service. Fire service to comply with the latest requirement by the State of Maine.

5. If an elevator is on independent service when the elevator is recalled on Phase I operation, a buzzer shall sound in the car and a message indicator will be activated.

END OF SECTION

SECTION 14240

HYDRAULIC ELEVATOR

1. GENERAL:

1.1 REFERENCES: Drawings and general provisions of Contract, including General Conditions and Division 1 specifications, apply to work in this section.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. 110 volt branch circuit to the terminals of the elevator controller for car light supply and 110 volt light and outlet in the elevator pit, complete with switch adjacent to the pit ladder as shown on Elevator Drawings.

B. Any cutting, patching or painting of walls and grouting under thresh-holds and hoistway frames.

C. Adequate supports for guide rail brackets.

D. Sill support angles.

E. Electrical current during erection and testing of equipment. 3 phase fused disconnect, & 110 volt fused disconnect

F. Necessary recesses to accommodate doors, sills, (min. 2-1/2" deep) and signal equipment such as indicators, push buttons, hall lanterns, etc.

G. Pit access ladder.

H. General Contractor to receive, handle and store in the building approximately ten (10) tons of elevator materials.

I. Smoke sensors in each elevator lobby and elevator machine room complete with necessary wiring to elevator controller. A shunt trip circuit breaker with heat detectors will also be provided as required.

J. 1-Dedicated phone. (If additional phone lines are required by elevator manufacturer they will be paid for by elevator contractor including monthly charges)

1.3 REGULATORY AGENCIES: Perform all work in accordance with the National Electrical Code, American Standard Safety Code and such state and local codes as may be applicable.

1.4 SUBMITTALS: Shop Drawings-

A. Submit six (6) blue print copies of elevator layout drawings to the Architect for approval.

B. Upon completion submit to Owner, warranty operating manual and maintenance information.

1.5 GUARANTEE:

A. Elevator Contractor shall guarantee that materials and workmanship of apparatus installed by him under these Specifications shall be first class in every respect; and that he will make good any defects not due to ordinary wear and tear or improper use which may develop within one (1) year from date of completion and installation.

B. In addition to the other requirements, inspection, tests and remedies herein provided upon completion of elevator installation and before final approval and final payment, Elevator Contractor shall make, in speed test with full maximum load on elevator to determine whether elevator equipment as installed meets the speed, capacity and all other requirements of the Specifications.

C. In event equipment does not meet all requirements of Specifications, Elevator Contractor shall promptly remove from the premises all work condemned by Architect as failing to conform to the contract and shall bear all expense of making good all work of other Contractors destroyed or damaged by such removal or replacement. If Elevator Contractor does not remedy such condemned work within a reasonable time, fixed by written notice from Architect, General Contractor may correct such condemned work at expense of Elevator Contractor and withhold such cost from final payment under contract price. In the event the remainder due under Contract price is insufficient to cover such a cost, Elevator Contractor shall, immediately upon request, reimburse General Contractor in full.

1.6 PERMITS, TAXES AND LICENSES: All permits, inspection fees and licenses necessary for the execution of the work shall be secured and paid for by the Elevator Contractor.

1.7 TEMPORARY USE: The General Contractor, Sub-contractors, Owner or others will not be permitted use of the elevators during construction except under a written agreement as stipulated by the Elevator Contractor.

2. PRODUCTS:

2.1 ACCEPTABLE MANUFACTURES:

A. Except as otherwise specified herein, or specifically approved by Architect, the Elevator Contractor shall be regularly engaged in installation of elevators of type specified herein, and shall be able to demonstrate at least three (3) installations of this type made

by him within the State of Maine which have provided satisfactory operation for a period of five (5) years prior to the date of receipt of General Bids, for this project.

B. Demonstrate that he has provided satisfactory maintenance service for elevators of type specified and that he has maintained a complete maintenance organization comprised of regularly employed inspectors and mechanics within the State of ME for a period of at least five (5) years prior to the date of receipt of General Bids.

C. Provide 1 year maintenance warrantee for ensuring reliable operation of elevator, and make available complete ongoing maintenance service package.

D. Elevator shall be equal to Canton Elevator Company, or approved equal. Elevator shall meet latest ANSI handicapped requirements and Maine State Elevator Code. Request for substitutions shall be received in writing 10 days prior to bid date and shall include contact information for at least 2 additional local companies capable of providing full maintenance type service on the unit after initial warranty period,

E. Delivery of elevator systems shall be guaranteed by Manufacturer to be on site sixteen (16) weeks after receipt of approved Shop Drawings. Shop Drawings shall be submitted to the General Contractor for review by the Architect within ten (10) days of Sub-Contractors award.

2.2 MATERIALS AND FABRICATIONS:

A. Description of equipment –

Quantity –	2 -Hydraulic
Capacity:	#1-2500 lbs.; #2 2500 lbs
Speed:	90 fpm
Operation:	Simplex sellective collective –confirm with owner
Travel:	as shown on Drawings
Type:	Holed hydraulic or holeless direct acting hydraulic
Power supply:	208 v 3 phase, 60 cycle.
Machine Location:	As shown on Drawings (remote)
Stops & Openings:	#1-2 stops inline, #2-3 stops inline

Car Enclosure:	High pressure laminate interior panels, overhead fluorescent lighting above egg acrylic suspended ceiling, stainless steel returns, and stainless steel car doors. Handrail on rear. Carpeted floor by others. One (1) set Protection pads and hooks per car Include: ADA compliant telephone Fan Emergency Lighting Proximity detectors, door protection
Hoistway Door Frames:	Hollow metal U.L. "B: labeled door, square frame
Door Size & Type:	3'-6" W x 7'-0"H; - (clear opening) finish to be baked enamel; color to be selected from standard selection charts
Door Operation:	D.C. Power Operation
Signals:	Illuminated halo buttons, (Braille) alarm bell, in car location. Hall position indicator at main floor level. In – Car Direction Lantern
Special Features:	Special handicap provisions Door Hold Key Service Independent Operation Key Switch Card reader provision
Motor HP:	3 Phase Power 25 HP Max
Starter	Solid state soft start

B. Jack unit:

1. The jack unit shall be designed and constructed in accordance with the applicable requirements of the American Standard Safety Code for Elevators A-17. It shall be of sufficient size to lift the gross load the height specified. It shall be factory tested to insure adequate strength and freedom for leakage. No brittle material, such as gray cast iron, shall be used in the jack construction.

2. The jack unit shall consist of the following parts: a plunger of heavy polished steel tubing accurately turned; a stop ring shall be electrically welded to the plunger to positively prevent plunger leaking its casing made of steel tubing and provided with a pipe connection and air bleeder; Brackets shall be welded to jack casing and supporting the elevator on pit channels.

3. A PVC cylinder protection system shall be installed. Union Guard corrosion protection to fill void no exceptions.

4. A standard wellhole with steel pipe casing to retain the hole shall be provided**.** All drilling spoils are to be removed by the general contractor. Water for drilling, if required, will be provided by others also. Should obstructions such as boulders, debris, water, quicksand or any other condition other than normal soil, clay or standard ledge be encountered, additional time to drill the hole will be treated as a change order. Work to cease until a change order is issued.

C. Car:

1. Platform and Sling: The platform and sling have a fabricated frame of formed and structural steel shapes, gusseted and rigidly welded. Flooring shall be wood top floor laid over wood sub-floor. Finished flooring shall be provided, by others, on top of the car platform.

2. The sling shall consist of heavy steel channel stiles properly affixed to a steel cross head and bolster, with adequate bracing members, to remove all strain from the car enclosure.

3. Steel bumper plates shall be affixed to bottom of bolster channels; and a platen plate with clamps and car screws shall be furnished for fastening sling to plunger.

D. Car doors: The car entrance shall be provided with horizontal sliding doors. Panel rigidity to be obtained by suitable steel reinforcements. Doors shall be hung on sheave hangers with polyurethane tires and sheaves not less than 2-1/2" diameter running on a polished steel track, and guided at the bottom by non-metallic shoes sliding in a smooth threshold groove.

E. Alarm bell: An emergency alarm bell shall be located in conformance with ANSI A-17 Code requirements, and connected to a plainly marked push button in the car. Alarm bell shall be connected to the emergency lighting power pack.

F. Guide and Guide Shoes: Guides for the elevator car shall be planed steel elevator guide rails, properly fastened to the building structure with steel brackets. The car stile shall be fitted at top and bottom with sliding guide shoes.

G. Power Unit:

1. (Oil pumping and control mechanism) shall be compactly and neatly designed with all of the components listed below combined in a self-contained unit; structural steel outer base with tank supports; floating inner base for mounting motor pump assembly; over head oil reservoir with tank cover and controller compartment with cover; metal drip pan; oil-hydraulic pump; electric motor; and oil control unit with the following components built into a single housing: a high pressure relief valve, a check valve, an automatic unloading up start valve, a lowering and leveling valve, and a magnetic controller, or a self contained submersible of manufactures standard type.

2. The pump shall be especially designed and manufactured for oil-hydraulic elevator service. It shall be of positive displacement screw type, inherently designed for steady discharge with minimum pulsations to give smooth and quiet operation. Output of pump shall not vary more than ten percent (10%) between no load and full load on elevator car.

3. Motor shall be especially designed for oil-hydraulic elevator service, of standard manufacturer and of duty rating to comply with specified speeds and loads.

4. Oil control unit shall consist of the following components, all built into a single housing. Welded manifolds with separate valves to accomplish each function will not be acceptable under this Specification. All adjustments shall be accessible and shall be made without removing the assembly from the oil lines:

    a. Relief valve shall be externally adjustable and shall be capable of bypassing the total oil flow without increasing back pressure more than ten percent (10%) above that required to barely open the valve.

    b. Up start and stop valve shall be externally adjustable, and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, insuring smooth up starts and up stops.

    c. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.

    d. Lowering valve and leveling valve shall be externally adjustable for drop-away speed, lowering speed, leveling speed and stopping speed to insure smooth "Down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling when slow down is initiated.

5. Electric controller shall be of the full magnetic type or solid-state integrated circuitry. Silver to silver contacts shall be utilized on all relays and contractors. Thermal overload relays to be provided to protect the motor. All component

switches to be mounted in a steel panel designed for wall to floor mounting. Shall have built in diagnostics, no proprietary tools required to service unit.

H. Mainline Strainer: A mainline strainer of the self-cleaning type, equipped with a 40-mesh element shall be furnished and installed in the oil line.

I. Failure Protection: The electrical control circuit shall be designed so that if a malfunction should occur, due to motor starter failure, oil becoming low in the system, or the car failing to reach a landing in the up direction within a predetermined time, the elevator car will automatically descend to the lowest terminal landing. If power operated doors are used, the doors will automatically open when the car reaches the landing to allow passengers to depart. The doors will then automatically close and all control buttons, except the "door open" button in the car station, shall be made inoperative.

J. Sound Isolating Coupling: Install a minimum of one in the oil line in the machine room between pump and jack

K. Oil-Hydraulic Silencer (muffler device): Install in oil line near power unit. It shall contain pulsation-absorbing material inserted in a blowout-proof housing arranged for inspecting interior parts without removing unit from oil line. Rubber hose without blowout-proof features will not be acceptable.

L. Vibration Pads: Mount under the power unit assembly to isolate the unit from the building structure.

M. Automatic Terminal Limits: Place electric limit switches in the hatchway near the terminal landing; designed to cut off the electric current and stop the car should it run beyond either terminal landing.

N. Automatic Self-leveling: Provide elevator with a self-leveling feature that will automatically bring the car to the floor landings. This self-leveling shall, within its zone, be entirely automatic and independent of the operating device, and shall correct for over travel or under travel. The car shall also be maintained approximately level with the landing regardless of the load.

O. Buffers: Furnish and install substantial buffers under the car in the elevator pit. They shall be mounted on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor and substantial extensions will be provided, if required. Buffers shall comply with ANSI A-17.1 Code requirements.

P. Car Top Inspection Station: A car top inspection station with an "emergency stop" switch and with constant pressure "up-down" direction buttons shall make the normal operating devices inoperative and give the inspector complete control of the elevator.

Q. Door Operation: Furnish and install a direct current motor driven heavy-duty operator designed to operate the car and hoistway doors simultaneously. Door movements shall be electrically cushioned at both limits of travel and door-operating mechanism shall be arranged for manual operation in event of power failure. The leading edge of the car door shall be provided with a retractable reversal edge arranged to automatically return car and hoistway doors to the open position in the event the doors are obstructed during closing cycle. Doors will then resume closing cycle.

Doors shall automatically open as the car arrives at the landing and shall automatically close after an adjustable time interval or when the car is dispatched to another landing. Direct drive geared operators, A.C. controlled units with oil checks, or other deviations for the above are not acceptable.

R. Interlock: Equip each hoistway entrance with an approved type interlock tested as required by Code. The interlock shall be designed to prevent operation of the car away from the landing until the doors are locked in the closed position as defined by Code and shall prevent opening the doors at any landing from the corridor side unless the car is at rest at the landing or is in the leveling zone and stopping at the landing. Interlocks shall bear Underwriter's Laboratories "B" label of approval.

S. Hoistway Door Unlocking Device: Provide hoistway door unlocking devices as specified by the ANSI A-17.1 Code to permit authorized persons to gain access to hoistway when elevator car is away from the landing.

T. Door Hangers and Tracks: For each hoistway sliding door, furnish and install sheave type two point suspension hangers and tracks complete. Sheaves shall be 2-1/2" in diameter and have polyurethane tires with ball bearings properly sealed to retain grease. Hangers shall be provided with an adjustable slide to take the up-thrust of the doors. Tracks are to be drawn steel shapes, smooth surface and shaped to conform to the hanger sleeves.

U. Hoistway Entrances: Hoistway entrances of the hollow metal, horizontal sliding type shall be furnished and installed complete at each of the hoistway openings. Note that entrances must be at least minimum legal width for wheelchair use, meeting ANSI A-17.1.

1. Entrances shall be manufacturer's standard design and shall bear Underwriter's Laboratories "B" labels. They shall consist of frames, sills, doors, hangers, hanger supports, hanger covers, fascia plates, and all necessary hardware. Finish to be baked on enamel chosen from manufacturer’s standard.

2. The entire front wall of the hoistway is to be left open or a rough opening provided which is 12" greater in width and 6" greater in height than the finished opening, until after entrances are installed. After guide rails are set and lined, the entrance

frames shall be installed in perfect alignment with the guide rails. Finish walls will then be completed by others.

V. ADA telephone shall be furnished with wiring from elevator cab to the machine room and telephone box. Wiring to be coordinated with Electrical Contractor and tied into outside phone system.

W. Operation (Selective Collective Automatic Push-button): Control of the elevator car shall be automatic in operation by means of a push-button in the car marked for each of the landing levels served and an "up-down" button at each intermediate landing with a call button at each terminal landing, wherein all stops registered by the momentary pressure of landing or car buttons shall be maintained until the car answers the call. An emergency stop switch shall be provided in the car push-button station which, when in the off position, will render the elevator inoperative, and which will enable attendant or passenger to stop the car at any point during its travel. Opening of this switch shall not cancel registered calls, and when the switch is closed the car will continue to answer calls that have been registered. Each landing station shall contain an illuminated push-button which shall "light-up" when pressed to indicate that a call has been registered to bring the car to that particular landing. A time delay non-interference feature shall be incorporated in the control mechanism to allow simple time for opening and closing car and hoistway doors before it is again placed in motion.

X. Special Emergency Service:

1. Special Emergency Service Operation shall be provided in compliance with the latest revision of the ASME/ANSI A17.1 or CAN3-B44 Code.

2. Special Emergency Service Phase I to return the elevator non-stop to a designated floor shall be initiated by an elevator smoke detector system or a keyswitch provided in a lobby fixture.

3. The smoke detector system is to be furnished by others. The elevator contractor shall provide contacts on the elevator controller to receive signals from the smoke detector system.

4. A keyswitch in the car shall be provided for in-car control of each elevator when on Phase II of Special Emergency Service. Fire service to comply with the latest requirement by the State of Maine.

5. If an elevator is on independent service when the elevator is recalled on Phase I operation, a buzzer shall sound in the car and a message indicator will be activated.

END OF SECTION

SECTION 015300 - FIRE PROTECTION

PART 1 – GENERAL

1.1 REFERENCES

A. All of the Contract Documents, including General and any Supplementary Conditions and Division 1-General Requirements, apply to the work of this section.

B. Examine all Drawings and all other Sections of the specifications for requirements therein affecting the work of this trade.

C. The fire suppression system drawings and hydraulic calculations that are a part of these fire protection documents have been developed and prepared for use in complying with permitting requirements. The installing contractor shall be responsible to prepare shop drawings hydraulic calculations, providing design narrative and to provide all other documentation required to be submitted for review by any Authority Having Jurisdiction, the architect and Registered Professional Engineer that has sealed and signed these documents.

D. This specification requires preparation and submissions of drawings and other documents, procurement of approvals and provision of a complete functional systems of automatic fire protection. As a result, this Section serves dual purposes of providing specifications and indicating design criteria for the Fire Protection Subcontractors use and guidance in preparing sprinkler installation drawings and other documents for approvals.

E. The fire protection work is partially shown on the drawings. Each bidder for work under this Section of the specifications shall establish for himself, the exact quantity of heads and all other materials and equipment required for the project and the exact extent of the work required for the project and the exact extend of the work required by all Authorities Having Jurisdiction. Refer to Architectural reflected ceiling plans for sprinkler head locations. Additional heads shall be provided at no additional cost as part of this Contract, as required, to satisfy the Code requirements.

1.2 DEFINITIONS

A. Words in the singular shall also mean and include the plural, wherever the context so indicates and words in the plural shall mean the singular, wherever the context so indicates.

B. Wherever the terms "shown on drawings" are used in the specifications, they shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.

C. Wherever the term "provide" is used in the specifications it will mean "furnish" and "install", "connect", "apply", "erect", "construct", or similar terms, unless otherwise indicated in the specifications.

D. Wherever the term "material" is used in the specifications it will mean any "product", "equipment", "device", "assembly", or "item" required under the Contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.

E. The terms "approved", or "approval" shall mean the written approval of the Architect.

F. The term "specification" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, including all drawings.

G. The terms "directed", "required", "permitted", "ordered", "designated", "prescribed" and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect. The terms "approved", "acceptable", "satisfactory" and similar words shall mean approved by, acceptable or satisfactory to the Architect. The terms "necessary", "responsible", "proper", "correct" and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.

H. "Piping" includes in addition to pipe or mains, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

I. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.

J. "Exposed" means not installed underground or "concealed" as defined above.

K. "Fire Protection Subcontractor" refers to the Subcontractor or his Subcontractors responsible for furnishing and installation of all work indicated in the Fire Protection specifications and as shown on the fire protection drawings.

L. Owners Insurance Underwriter

1.3 SCOPE

A. Perform work and provide material and equipment as shown on the Fire Protection Drawings and as specified or indicated in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide a complete and fully functional installation.

B. Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

C. Give notices, file plans, obtain permits and licenses, pay fees and obtain necessary approvals from all Authorities Have Jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings and Addenda all of which are part of these Contract Documents.

D. The Scope of the Work consists of the installation of all materials to be furnished under this Section, including all associated work required, and without limiting the generality thereof, to include:

Hydrant flow testing.
Complete automatic sprinkler system including main alarm check valve.
Automatic sprinkler heads (including all heads to be center of tile).
Inspector's test stations, connections and drain risers.
Fire department connections.
Temporary standpipes and fire department valves for emergency use during construction.
Supervisory (Tamper) switches.
Flow switches.
Escutcheons.
Coordination and co-operation.
Catalog cuts, shop drawings and hydraulic calculations verifying pipe sizing.
Connection to new Fire Service 10’-0” beyond building wall.
Double check valve assembly
Core drilling of holes up to and including 12" diameter
Sleeves, caulking and fireproofing of sleeves, inserts and hangers
Staging and planking up to and including 8 feet in height
Testing and certificates
Record drawings - AutoCAD 2010
Operations and Maintenance manuals
Valve tags and charts
Instructions
Spare heads in cabinet, wrenches
Hoisting, rigging, setting of all piping and equipment as outlined in General Conditions
Fees, permits, royalties, guarantees, submittals to and approvals from City of New Haven Fire Department and Owner's Insurance Agent and all other State and Local Authorities exercising jurisdiction over this project.
Pressure gauges at top of each riser
Furnishing of access panels
Drains
Coordination drawings - AutoCAD 2010
Seismic Bracing
Building automation system
Expansion loops
Control and Interlocking wiring
Vibration Isolators

E. The following work is not included in this Section and is to be performed under other Sections:

1. Cutting and patching.
2. Temporary water, facilities and controls.
3. Housekeeping pads, thrust blocks for exterior piping, cutting and patching in concrete:
4. Flashing of all pipe penetrations.
5. Finish painting.
6. Plumbing
7. Heating, ventilating and air conditioning work
8. Electrical power wiring, wiring of tamper and alarm flow switches to building fire alarm system.
9. Installation of access panels furnished under this Section shall be by the Trades as designated by the Construction Manager.
10. Painting, except as specified herein.
11. Electric power wiring only for all equipment.
12. Temporary light, power, water, heat, gas and sanitary facilities for use during construction and testing.
13. Sprinkler waste outlet.
14. Fire alarm system and controls.

1.4 CODES, STANDARDS AND REFERENCES

A. All materials and workmanship shall comply with all latest editions of applicable Codes, Local and State Requirements and requirements of all Authorities having jurisdiction, and these specifications.

B. In case of difference between any Regulations and the Contract Documents, the Fire Protection Subcontractor shall promptly notify the Architect in writing of any such difference.

C. In case of conflict between the Contract Documents and the requirements of any Code or requirements of any Authorities Having Jurisdiction, the most stringent requirements of the aforementioned shall govern. Fire Protection Subcontractor shall promptly notify the Architect in writing of any such occurrence.

D. Should the Fire Protection Subcontractor perform any work that does not comply with the requirements of the specifications and applicable Codes, he shall bear all costs arising in correcting the deficiencies to the satisfaction of the Architect.

E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations and the applicable requirements of the following accepted Codes and Standards, without limiting the number, as follows:

1. Local and state building, plumbing, mechanical, electrical, fire and health department codes.
2. National Fire Protection Association (NFPA)
3. Occupational Safety and Health Act (OSHA)
4. Building Owner's Insurance Company
5. Underwriters' Laboratories (UL)
6. International Building Code (IBC)

F. In these specifications, references made to Code are intended to indicate the accepted volume or publication of the Standard or applicable Code. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:

1. ANSI American National Standards Institute
2. ASME American Society of Mechanical Engineers
3. ASTM American Society of Testing Materials
4. AWS American Welding Society
5. CS Commercial Standards, U.S. Department of Commerce
6. MSS Manufacturers Standardization Society of the Valve and Fittings Industry
7. NEMA National Electrical Manufacturers Association
8. UL Underwriters' Laboratories, Inc.

G. Specific reference is made to the following NFPA codes which shall govern provision of work as specified and as required by codes and authorities.

1. No. 13 Installation of Sprinkler Systems
2. No. 25 Inspection, Testing, and maintenance of water based Fire Protection Systems
3. No. 72 National Fire Alarm Code
4. No. 101 Life Safety Code

H. The Fire Protection Subcontractor for the work shall give all necessary notices, obtain and pay for all permits, pay all taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. The Fire Protection Subcontractor shall obtain all required Certificates of Inspection for his work and deliver same to the Architect before request for acceptance of his portion of work is made and before final payment.

1.5 GUARANTEE

A. Attention is directed to provisions of the General Conditions and Supplementary General Conditions regarding guarantees and warranties for work under this Contract.

B. Manufacturers shall provide their standard guarantees for work under this Contract. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and Construction Manager may have by Law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the Fire Protection systems, as determined by the Architect and shall remain in effect for a period of one (1) year thereafter.

C. All materials, items of equipment and workmanship furnished under each Section shall carry the standard warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the Fire Protection Subcontractor including all other damage done to areas, materials and other systems resulting from this failure.

D. The Fire Protection Subcontractor shall guarantee that all elements of the systems provided under his Contract, are sufficient to meet the specified performance requirements as set forth herein or as indicated.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the Fire Protection Subcontractor within one (1) week at no cost to the Owner.

F. The Fire Protection Subcontractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

G. Provide 24 hour service beginning on the date the project is first occupied, whether or not fully occupied, and lasting until the termination of the guarantee period. Service shall be at not cost to the Owner. Submit name and a phone number that will be answered on a 24 hour basis each day of the week, for the duration of the service.

H. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's satisfaction, advise Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Architect will suggest course of action.

1.6 THE SUBCONTRACTOR

A. The Fire Protection Subcontractor shall study all Contract Documents included under this Contract to determine exactly the extent of work provided under this Section, and in installing new equipment and systems and coordinating the work with the other Trades.

B. The Fire Protection Subcontractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications.

C. The Fire Protection Subcontractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed

directly or indirectly by the Fire Protection Subcontractor shall perform their work according to all the conditions as set forth in these specifications.

D. The Fire Protection Subcontractor shall furnish all materials and do all work in accordance with these specifications and any supplementary documents provided by the Architect. The work shall include every item shown on the drawings and/or required by the specifications as interpreted by the Architect. All work and materials furnished and installed shall be new and of the best quality and workmanship. The Fire Protection Subcontractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed.

1.7 COORDINATION OF WORK

A. The Fire Protection Subcontractor shall compare his drawings and specifications with those of other Trades and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the mechanical work. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, Fire Protection Subcontractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the Fire Protection work caused by the Fire Protection Subcontractor's neglect, shall be made by him at his own expense, to the Architect's satisfaction.

B. Locations of pipes and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. The Fire Protection Subcontractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component.

C. Lines which pitch shall have the right-of-way over those which do not pitch. For example, waste piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.

D. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The Fire Protection Subcontractor shall provide manual air vents and drains as required for his work to effect these offsets, transitions and changes in direction. All work shall be installed in a way to permit removal (without damage to other parts) of coils, filters, control appurtenances, fan shafts and wheels, filters, belt guards, sheaves and drives and all other system components provided under this Contract requiring periodic replacement or maintenance. All piping shall be arranged in a manner to clear the openings of swinging overhead access doors as well as ceiling tiles.

E. The Contract Drawings are diagrammatic only intending to show general runs and locations of piping, equipment, and specialties and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other

Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom. All changes required due to job conditions must be approved by the Architect prior to commencement of work.

F. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, flow switches, etc., such conflicts shall be reported to the Architect prior to signing of the Contract. If such action is not taken, the Fire Protection Subcontractor shall furnish such items as part of his work as necessary, for complete and operable systems and equipment, as determined by the Architect.

G. Where drawing details, plans and/or specification requirements are in conflict and where pipe sizes of same pipe run is shown to be different between plans and/or between plans and sections or details, the most stringent requirement will be included in the Contract. Fire Protection systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.

H. Final location of all sprinkler heads, alarms, control devices shall be coordinated with the Architectural reflected ceiling plans and/or other Architectural details, as applicable. Offsets of piping, added sprinkler heads, elbows, etc., shall be provided as required to comply with the architectural reflected ceiling plans. Obtain approval of locations of all devices from Architect in the field. Additional heads, piping, fittings, etc., shall be provided to accomplish the above requirement, as required, all as part of this Contract, at no extra cost to the Owner.

I. Included as part of coordination, this fire protection contractor shall maintain service and maintenance access around all fire protection equipment.

1.8 COORDINATION DRAWINGS

A. Before materials are purchased, fabricated or work is begun, each Subcontractor shall prepare coordination drawings for all floors/areas, including buried systems/services (all-Trade-composite at 3/8 inch scale), showing the size and location of his equipment and lines, in the manner described herein under General Requirements - Section 01040.

B. Coordination drawings are for the architect’s use during construction and shall not be construed as shop drawings or as replacing and shop drawings. The coordination drawings, when corrected for actual “as-built” conditions, will be reviewed by the Architect, corrected and become the Record Drawings to be submitted to the Owner for his use.

C. The cost of producing and reproducing the drawings will be included under the Contract of each Trade, including the cost or preparation of the Architectural building outlines. The HVAC

Contractor shall take the lead to produce the Architectural backgrounds, show all ductwork, piping, etc., and circulate the drawings to any of his Subcontractors and the other Trades (Plumbing, Fire Protection, Electrical), so that they can indicate all their work as directed by the Architect as required, to result in a fully coordinated installation.

D. In addition to the regular coordination drawing review, the mechanical work will also be reviewed by the Architect/Engineer to ensure that the system and equipment arrangements are suitable to provide maintenance access and service as follows:

1. Valves and instrumentation should be grouped where possible and positioned in accessible locations.

E. Prepare a complete set of computer based AutoCad 2005 drawings at scale not less than 3/8" equals 1'-0", showing basic layout for the structure and other information as needed for preparation of Coordination Drawings. The drawings shall indicate the layout of all specialty tradework as indicated herein and shall be designated as Coordination Drawings. The Contractors can purchase a copy of the floor plans on disk from the engineer to assist in the preparation of Coordination Drawings. The Contractor shall provide a minimum of two (2) weeks notice to the engineer for the preparation of the disk. A signed liability release form will be required from the Contractor prior to the release of the disk from the engineer.

F. Highlight all fire rated partitions on the Coordination Drawings for appropriate coordination.

G. The main paths for the installation or removal of equipment from mechanical and electrical rooms shall be clearly indicated on the Coordination Drawings.

H. Each of the specialty trades shall add its work to the base drawings with appropriate elevations and grid dimensions. Specialty trade information shall be required for fan rooms and mechanical rooms, horizontal exits from duct shafts, crossovers and for spaces in the above ceilings where congestion of work may occur such as corridors and, where required, entire floors. Drawings shall indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions and other services. Indicate elevations relative to finish floor for bottom of ductwork and piping and conduit 6" greater in diameter.

1. Specialty Trade shall include:

a. Plumbing system.
b. HVAC piping and equipment
c. Electrical
d. Sheet Metal Work
e. Sprinkler System
f. ATC system

I. Upon completing their portion of the Coordination Drawings, each specialty trade shall sign, date and return Coordination Drawings to the Contractor.

J. Where conflicts occur with placement of materials of various trades, the General Contractor shall be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialized and dated by the affected specialty trade subcontractor. The General Contractor shall then final date and sign each drawing.

K. Fabrication shall not start until Coordinate Drawings have been distributed to all parties as indicated herein.

L. Format: Coordination Drawings (plans only) shall be done using CAD in AutoCAD, 2005 in either IBM or Mac Format, disks shall be given to the architect for future transfer to Owner. Coordination Drawings will be used as base for as-built drawings.

M. Distribution of Coordination Drawings:

1. The General Contractor shall provide one print of each Coordination Drawing to:

    a. Each specialty trade Subcontractor
    b. Owner
    c. Construction Manager
    d. Architect (for record purposes)

N. After distribution:

1. The method used to resolve interferences not previously identified shall be as in paragraph F. above. Distribute revised Coordination Drawings to all parties listed above.

O. Coordination Drawings include but are not necessarily limited to:

1. Structure
2. Partition/room layout, including indication of smoke and fire resistance rated partitions.
3. Ceiling layout and heights
4. Light fixtures.
5. Access Panels
6. Sheet metal, heating cols, boxes, grilles, diffusers, etc.
7. All heating piping and valves.
8. Smoke and fire dampers.
9. Soil, waste and vent piping.
10. Major water and gases.
11. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit. Motor control centers, starters and disconnects.

12. Sprinkler piping and heads.
13. All equipment, including items in the Contract as well as O.F.C.I. and O.F.I. items.
14. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur indicates areas in which the required access area may be greater than the suspected grid systems.
15. Dental Vacuum & Dental Air System

1.9 GIVING INFORMATION

A. The Fire Protection Subcontractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the Architect and other Subcontractors sufficiently in advance of the work so that all openings may be built in advance.

1.10 EQUIPMENT AND MATERIALS

A. Equipment and materials shall be delivered to the site and stored in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls, switches, etc., shall be stored in dry, heated spaces.

B. The Fire Protection Subcontractor shall have his equipment tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned, polished thoroughly and turned over the Owner in a condition satisfactory to the Architect. Damage or defects developing before acceptance of the work shall be made good at the Fire Protection Subcontractor's expense.

C. The Fire Protection Subcontractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.

D. The manufacturers listed within this specification have been pre-selected for use on this project. No submittal will be accepted from a manufacturer other than specified. Should the Fire Protection Subcontractor wish to propose a substitution during the bid period, such request shall be made in writing to the Architect, no less than seven (7) working days, prior to bid date. If substitutions are deemed acceptable, such items shall be issued on an Addendum, prior to bid due date. The above requirement is mandatory.

E. Manufacturers' directions shall be followed completely in the delivery, storage, protection and installation of any equipment. Promptly notify the Architect in writing of any conflict between

any requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's written instructions before proceeding with the work. Should the Fire Protection Subcontractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.

F. The Fire Protection Subcontractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.

G. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of the Fire Protection Subcontractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, the Fire Protection Subcontractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Fire Protection Subcontractor shall make all necessary changes in all affected related work provided under other Sections including location of roughing in connections by other Trades, electrical requirements, piping, supports, insulation, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.

H. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. Equipment and materials shall be products which will meet with the acceptance of the Authorities having jurisdiction over the work and as specified hereinbefore. Where such acceptance is contingent upon having the products listed or labeled by FM, UL or other testing laboratories, the products shall be so listed or labeled. Where no specific indication as to the type or quality of material or equipment is indicated, a first class standard article shall be provided.

I. All equipment of one type (such as valves, heads, switches, etc.,) shall be the product of one manufacturer, unless otherwise specified.

1.11 CUTTING AND PATCHING

A. All concrete and masonry equipment bases and pads, curbs, chases, pockets and openings required for the proper installation of the work under this Contract will be provided by the General Contractor, using information, as shown on the drawings and/or as required and furnished by the Fire Protection Subcontractor. At a minimum, concrete bases (housekeeping) pads shall be 4 inches high and extending 3 inches on all sides beyond equipment (for all base mounted equipment).

B. In addition to the requirements outlined herein for cutting and patching, the Fire Protection Subcontractor shall be responsible for core drilling all holes required for work under his Contract and with the written approval of the Architect.

C. In no case shall the Fire Protection Subcontractor cut into any structural elements without the written approval of the Architect.

1.12 USE OF PREMISES

A. The Fire Protection Subcontractor shall confine all of his apparatus and storage of materials and construction to the work area or limits as directed by the Architect and he shall not encumber the premises with his materials.

B. In storing materials within areas (structure or ground), or when used as a shop, the Fire Protection Subcontractor shall consult with the Construction Manager and shall restrict his storage to space designated for such purposes. The Fire Protection Subcontractor will be held responsible for repairs, patching or cleaning arising from any unauthorized use of premises.

C. Notwithstanding any approvals or instructions which must be obtained by the Fire Protection Subcontractor from the Architect in connection with use of premises, the responsibility for the safe working conditions at the site shall remain the Fire Protection Subcontractor's and the Architect or Owner shall not be deemed to have any responsibility or liability in connection therewith.

1.13 PROTECTION

A. All materials such as valves, fittings, piping etc., shall be properly protected and all piping openings shall be temporarily closed by the Fire Protection Subcontractor installing same, so to prevent obstruction and damage. To protect the equipment, temporary covers of substantial nature shall be provided to assure that items such as fire department valves, cabinets, etc., are not damaged. The Fire Protection Subcontractor shall take precautions to protect his materials from damage and theft.

B. The Fire Protection Subcontractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or systems provided under his Contract.

1.14 DAMAGE TO OTHER WORK, CORRECTION OF WORK AND EXTRA WORK

A. The Fire Protection Subcontractor shall be held responsible and shall pay for all damages caused by his work to the building structure, equipment, piping, duct systems, etc., and all work and finishes installed under this Contract in the building. Repair of such damage shall be done as herein before specified, at the expense of the Fire Protection Subcontractor and to the Architect's satisfaction.

B. The Fire Protection Subcontractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after completion of work and whether or not fabricated, installed or

completed. The Fire Protection Subcontractor shall bear all costs of correcting such rejected work.

C. No claim for extra work will be allowed unless it is authorized by the Architect in writing before commencement of the extra said work.

1.15 PIPE SLEEVES, PLATES AND ESCUTCHEONS, FIRE STOPPING AND SMOKEPROOFING

A. Where pipes pass through all walls or floors, the Fire Protection Subcontractor shall provide and set individual sleeves for each pipe and all other work under his charge, as necessary for passage of all pipes. Sleeves shall be of sufficient size to provide 1/2 inch air space around the pipe passing through it. All openings shall be sealed, smokeproofed and made tight. The Fire Protection Subcontractor shall be responsible for the exact location of sleeves provided under this Contract and shall coordinate all requirements for piping sleeves.

B. The Fire Protection Subcontractor, for work under his charge, shall determine the diameter of each individual wall opening or sleeve before ordering, fabrication or installation.

C. Sleeves and inserts shall not be used in any portions of the building, where their use would impair the strength or construction features of the building. Elimination of sleeves must be approved by the Architect.

D. Provide chrome-plated brass escutcheons with set screw for exposed piping, in all areas. In mechanical rooms use plain brass or cast iron escutcheons suitable for painting. All escutcheons shall be sized to fit the bare pipe or insulation in a snug and neat manner. They shall be of sufficient size to cover sleeved openings for the pipes and of sufficient depth to cover sleeves projecting above floors. Escutcheons shall be as manufactured by Beaton and Caldwell, Dearborn Brass or Grinnell.

E. Exterior wall sleeve through masonry walls shall be made water tight by the use of a Mechanical Seal Joint as manufactured by Century Products Link Seal.

F. Pipe sleeves shall be made of Schedule 40 pipe, 16 gauge galvanized steel or 16 gauge steel as follows:

1. Sleeves on pipes passing through masonry or concrete construction shall be Schedule 40 pipe.

2. Sleeves passing through masonry partitions shall be 16 gauge steel unless required otherwise by item 1. above.3. Sleeves on pipes passing through drywall construction shall be 16 gauge galvanized steel.

3. Sleeves on pipes passing through fire rated drywall partitions shall be 16 gauge steel.

4. Sleeves required on all pipes passing through all walls.

G. Pipe sleeves shall be set as follows:

1. Set sleeves 1 inch above finish floor (6 inches at penthouses and mechanical rooms) and flush on each side of walls, except sleeves through floor occurring in walls and partitions shall terminate flush with finish floor.

2. Sleeves shall be set securely in place before concrete is poured.

H. The Fire Protection Subcontractor shall firestop or smokestop the space between the sleeves provided under his Contract and pipes as applicable, as required by general conditions.

1.16 WATERPROOFING, FLASHING AND COUNTERFLASHING

A. Unless specifically indicated otherwise, the Fire Protection Subcontractor shall provide all counterflashing and waterproofing of all piping, and equipment provided by him, which pierce roofs, walls and other weather barrier surfaces. All work under this paragraph shall be coordinated with the Construction Manager.

B. All work shall be performed in a workmanlike manner to assure weatherproof installation. Any leaks developed due to this Subcontractor's work shall be repaired at his expense, to the Architect's satisfaction.

C. Pipes passing through slabs shall have the sleeve extended above floors as hereinbefore specified to retain any water and the space between the pipe and sleeve caulked with lead wool. The top shall be sealed with lead and the bottom shall be sealed with monolastic caulking compound. The space between the outside of the sleeve and the floor slab shall be caulked watertight sufficiently to hold 2 inches of standing water.

D. All flashing required for piping penetrations shall be provided by the Construction Manager.

1.17 MISCELLANEOUS IRON AND STEEL

A. The Fire Protection Subcontractor shall provide all steel supports and hangers as shown on the drawings and/or required to support all Fire Protection equipment, systems and materials provided under this Contract.

B. All work shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets and framework shall be properly sized and strongly constructed.

C. Measurements shall be taken on the job and worked out to suit adjoining and connecting work. Members shall be straight, true and accurately fitted.

D. Drilling, cutting and fitting shall be done as required to properly install the work and accommodate the work of other Trades as directed by them.

E. Members shall be generally welded except that bolting may be used for field assembly where welding would be impractical.

F. All shop and field fabricated iron and steel work shall be cleaned and dried and given a coat of rust inhibiting paint on all surfaces and in all openings and crevices.

1.18 ELECTRICAL WORK, MOTORS, MOTOR CONTROLLERS

A. All electrical apparatus and controls furnished as a part of the Fire Protection work shall conform to applicable requirements under Electrical Section.

B. The Fire Protection Subcontractor shall provide the Electrical Subcontractor with all electrical requirements within thirty (15) days from date of Contract to allow proper coordination of Trades by the General Contractor.

C. The Fire Protection Subcontractor shall verify with the Electrical Subcontractor available electrical characteristics before ordering any equipment or motors.

1.19 IDENTIFICATION OF MATERIALS

A. All equipment used in the Fire Protection systems shall have a permanently attached nameplate identifying the manufacturer, service, size, serial number or model number, etc. The nameplates shall be kept clean and readable at all times.

B. Each item of equipment not provided with a manufacturer's nameplate, shall be identified by a permanently attached nameplate made of black surface, white core laminated bakelite with 1 inch high indented letters. Nameplates shall be minimum of 5 inches long by 3 inches wide and bear the equipment name as designated in the equipment schedules or the specifications. Nameplates shall be as fabricated by Seton Nameplate Company, Atlantic Engraving Company, W.H. Brady Company or approved equal.

C. A legend showing the service and an arrow indicating the direction of flow shall be applied on each pipe installed by the Fire Protection Subcontractor.

D. The piping shall be identified in the following locations and where directed by the Architect.

1. Pipe mains and branches every 15 feet.
2. At each valve.
3. Each wall penetration (both sides).
4. Each riser including branch risers from mains.
5. At each piece of equipment.

E. The identification of piping shall be coordinated with the Owner. Obtain approval of Architect prior to installation. The letter size and background color shall conform to the ANSI Scheme for the Identification of Piping Systems (ANSI 13 latest amendment).

1.20 VALVE TAGS, NAMEPLATES AND CHARTS

A. All valves on pipes of every description installed by the Fire Protection Subcontractor, shall be provided with neat circular brass valve tags of at least 1 1/2 inches in diameter, attached with brass hook to each valve stem or handle. Tags shall have stamped on, in letters as large as practical, the number of the valve and the service, such as "FP", WSP, DSP, etc., for Fire Protection, wet sprinkler, dry sprinkler. The numbers of each service shall be consecutive. Obtain approval of Architect prior to installation.

B. All numbers utilized shall correspond to numbers indicated for valves on the Record Drawings and on two (2) printed detailed lists. These printed lists shall state the numbers and locations of each valve and the equipment or system which it controls and other necessary information such as requiring the opening or closing of another valve or valves when any one valve is to be opened and closed.

C. These printed lists shall be prepared in form to meet approval of the Architect and shall be framed under glass.

D. The Fire Protection Subcontractor shall provide for his work all valve charts including the Fire Protection Subcontractor's name and telephone number; date of chart; name and telephone number of Architectural Firm and Consulting Engineering Firm.

1.21 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

A. Refer to Section 01700 of Division 1 - General requirements for the requirements of this Section.

1.22 MANUFACTURER'S REPRESENTATIVE FOR START-UP OF SYSTEMS

A. The Fire Protection Subcontractor shall provide, at appropriate time or as directed by the Architect, the onsite services of a competent factory trained Engineer or authorized representative of particular manufacturer of equipment such as for the fire pump to instruct the Owner, inspect, adjust, test and place in proper operating condition any item provided by him, as applicable.

B. The Fire Protection Subcontractor, as applicable, shall commission and set in operating condition all major equipment and systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. In no case will major systems and equipment be commissioned by any of the Subcontractor's forces alone, without the assistance or presence of the equipment manufacturers.

C. A written report shall be issued by the particular equipment manufacturer and the Fire Protection Subcontractor summarizing the results of the start-up and performance of each system for the Architect's record. No additional compensation will be allowed for any Subcontractor for such services.

1.23 ELECTRICAL ROOM REQUIREMENTS

A. The Fire Protection Subcontractor shall not install any piping, or equipment in or through electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms, unless piping, or equipment is intended to serve these rooms. Additionally, no piping will be installed above electric panels or within the limits of any Code requirements. If the Fire Protection Subcontractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.

1.24 RECORD DRAWINGS

A. The Fire Protection Subcontractor shall maintain current at the site a set of his drawings on which he shall accurately show the actual installation of all work provided under his Contract indicating any variation from the Contract Drawings, in accordance with the General Conditions and Supplementary General Conditions. Changes whether resulting from formal change orders or other instructions issued by the architect shall be recorded. Include changes in sizes, location and dimensions of piping, equipment, etc.

B. Utilizing the coordination drawings described herein before, the Fire Protection Subcontractor shall modify/correct/edit the fire protection work on the above CAD coordination drawings, to obtain a “CAD” set of Record Drawings. Provide (2) blackline prints (2) copies of record drawing CAD files.

C. A marked-up and colored-up set of prints on-site will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner’s representatives and they shall be corrected if found either inaccurate or incomplete. This procedure is mandatory.

D. Coordination drawings are for the Contractor’s, Architect’s, and Owner’s use during construction and shall not be construed as replacing any shop drawings. The cad coordination drawings, when corrected for actual “as-built” conditions, will be reviewed by the Architect, corrected and will be used to formulate the Record Drawings to be submitted to the Owner for his use.

E. The Fire Protection Subcontractor shall submit a set of CAD files on disc marked "AS-BUILTS". All costs associated with the production and reproduction of the CAD files shall be included under the fire protection bid for work under the fire protection contracts.

1.25 HOISTING EQUIPMENT AND MACHINERY

A. Refer to Section 01500 of Division 1 - General Requirements for the requirements of this Section.

1.26 STAGING

A. Refer to Section 01500 of Division 1 - General Requirements for the requirements of this Section.

1.27 SYSTEM DESIGN CRITERIA

A. Sprinkler systems and all components, piping, valves, head location, ratings, etc., shall be designed in accordance with NFPA 13, International Building Code and Owners Insurance Company and other applicable NFPA pamphlets governing the installation of alarm valves, system drains, etc. Fire Protection Subcontractor shall submit his shop drawings to City of Portland Fire Department and Owner's Insurance Company for approval prior to submission to Architect for approval.

B. The fire protection work is partially shown on the Fire Protection drawings. Each bidder for work under this Section of the specifications shall establish for himself, the exact quantity of heads required for the project and the exact extent of the work required. Refer to Architectural reflected ceiling plans for preferred sprinkler head locations. Additional heads shall be provided as part of this Contract, as required, to satisfy the Code requirements for the hazard stated.

C. Each Bidder shall refer fire protection drawings for major fire protection system's components, piping, as to which areas are to have fire department valves, hose cabinets, etc.

D. Provide sprinkler system in all areas that are a part of this Contract.

E. Hydraulic calculations shall be based on flow characteristics specified herein and on actual flow test performed/data obtained by the Fire Protection Subcontractor. The Fire Protection Subcontractor shall perform his own up-to-date flow test to hydraulically calculate this project. The Fire Protection Subcontractor shall submit to the Architect for his review; indication of test location, date, flow, residual and static pressure, etc., as outlined in NFPA #13. The Fire Protection Subcontractor shall coordinate the flow test with the Owner and Portland Water District and pay all costs and fees associated with flow test at no additional cost to the Owners.

F. Sprinkler system design shall be based on the following information and in accordance with the Owner's Insurance Company requirements:

1. Sprinkler systems shall be provided throughout the building and shall be hydraulically calculated to provide densities as specified on the drawings with hose allowance as required.

2. Flow Test Data

   a. Test Date: (For information only - see 3A below)
   b. Agency: Portland Water District
   c. Static Pressure:
   d. Residual Pressure:
   e. Flow Rate:
   f. Location: Steven's Avenue, Portland, ME

3A. Sprinkler contractor shall be required to perform their own hydrant flow-test prior to design. Coordinate with Portland Water District. Pay all required fees.

4. The hydraulic calculations shall include the hydraulically most remote areas for systems supplied by more than one combination riser. Hydraulic calculations shall show the remote areas being supplied solely from the hydraulically most remote combination riser.

G. The Fire Protection Subcontractor shall state in his bid the exact number of heads he deems necessary to adequately sprinkler the entire project, including the unit cost to add or deduct a single head from this stated quantity. Head cost shall include the provision of 10'0" linear feet of pipe and required elbows and offsets customarily associated with the installation of each type of head to be installed.

H. The Fire Protection Subcontractor will be required to prepare detailed shop drawings as hereinbefore specified. This information in the form of a single "Package" shall be submitted to the Architect for review and approval prior to fabrication and installation. "Package" shall bear approval of Local Building Department, Local Fire Department and Underwriter's Agent of Owner's Insurance Company prior to submission to Architect for his review. Include flow test information noted above.

1.28 SUBMITTALS

A. Shop drawing submittals shall be prepared and submitted as described herein and in accordance with Section 01300 - Division 1 - General Requirements and as modified and noted hereinafter.

B. Prior to final shop drawing submittals, prepare HEAD LOCATION ONLY DRAWINGS depicting all sprinkler head locations and submit them to Architect for approval. These drawings shall show locations of all heads and all required dimensions, etc., and shall show sprinklers, lights, HVAC diffusers, ceiling tile patterns and access panel locations. This must be provided. Refer to Section 1.2A of this specification for other submissions.

C. Disposition of shop drawings shall not relieve the Fire Protection Subcontractor from the responsibility for deviations from drawings or specifications, unless he has submitted in writing a

letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Architect, nor shall such disposition of shop drawings relieve the Fire Protection Subcontractor from responsibility for errors in shop drawings or schedules.

D. Submittal Procedures and Format:

1. Review submittal packages for compliance with Contract Documents and then submit to Architect for review.

2. Verify quantities and type of medium to be submitted as outlined in Section 01300.

3. Each Shop Drawing shall indicate in title block, and each Product Data package shall indicate on cover sheet, the following information:

4. Title.

5. Name and location of project.

6. Names of Architect, Engineer, Contractor and Subcontractor(s).

7. Names of manufacturer, supplier, vendor, etc.

8. Date of submittal.

9. Whether original submittal or resubmitted.

10. Verify scale and type of drawings required.

11. Shop Drawings showing layouts of systems shall contain sufficient plans, elevations, sections, details and schematics to describe work clearly. They shall be minimum 1/8" = 1'0" scale unless specified otherwise. Provide larger scale details as necessary. Drawings shall show elements of Architect's reflected ceiling plan, exposed ductwork, walls, partitions, diffusers, registers, grilles, access panels, sleeves and other aspects of construction.

12. All firewalls and smoke partitions must be highlighted on the drawings for appropriate coordination.

13. Shop drawings showing manufacturer's product data shall contain detailed dimensional drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data, alone, is not acceptable), electrical requirements and wiring diagrams. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and

other information necessary to demonstrate compliance with all requirements of Contract Documents.

E. Shop drawings shall include but shall not be limited to the following:

1. Sprinkler work layout drawings, including location and sizes of piping, pumps, heads, guards, flushing connections, drains, test stations, alarm valves, bells, gongs, and all other accessories as required by NFPA #13.

2. Hydraulic calculations per NFPA #13, and Owner's Insurance.

3. Equipment Cuts for:

a. Alarm bell.
b. Alarm valves.
c. Inspector's test valves.
d. Valves, gauges, drains and piping.
e. Guards, spare head cabinet.
f. Fire Department Connections with ball drip and check valves.
g. Hangers, supports.
h. Sprinkler heads, escutcheons.
i. Flow switches, tamper switches.
j. Access panels.

1.29 WORKING PLANS

A. Submit Working Plans and hydraulic calculations signed and sealed by Professional Engineer registered in state in which project is located to authorities that have jurisdiction, including:

1. Architect - as outlined in Section 01300
2. Insurance Underwriter
3. Fire Department
4. Authorities Having Jurisdiction

B. Submit Working Plans in one complete package. When it is not possible to submit entire system design in one package due to job conditions, submit plans of entire building indicating area not yet defined.

C. Working Plans shall be at least 1/8" = 1' scale on sheets of uniform size. Working Plans shall show all data required by NFPA Standards.

D. Working Plans will be subject to Architect's final approval. Submit to Architect after review by other authorities. If necessary to submit plans to Architect before review by other authorities,

identify authorities that have not reviewed plans and resubmit for final approval when review by all parties is complete.

E. Pipe sizing shall be based on hydraulic calculations in accordance with NFPA requirements.

F. Working Plans are fabrication drawings provided to indicate actual sprinkler system and/or combination system piping layout.

1.30 SITE VISIT

A. Before commencing any work under this section, verify all governing dimensions, elevations and locations at the building and examine all adjoining work on which this work is in any way dependent for its perfect efficiency according to the intent of these specifications. Visit and investigate all spaces and conditions to become familiar with installation and all requirements prior to bidding.

B. Each bidder shall visit the site and inspect all conditions affecting any aspect of the work. Failure to do so and misinterpretation of the plans and specifications resulting therefrom shall be entirely the responsibility of the bidder.

1.31 CORE DRILLING

A. This subcontractor shall perform all core drilling required for the proper installation of the fire protection system. Locate all required openings and prior to coring coordinate the opening with the General Contractor. Thoroughly investigate the conditions in the vicinity of the required opening prior to cutting. Care must be taken so as to not to disturb the hospital systems. Locate all other openings required for the General Contractor. All cored openings are to be by Fire Protection Contractor and all other openings are by the General Contractor. Patching of walls and openings shall be preformed by the respective trade responsible for the finish material in which the opening is made.

1.32 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Instruct to the Owner's satisfaction such persons as the Owner designated, in the proper operation and maintenance of all Fire Protection systems and equipment and their parts.

B. Furnish operating and maintenance manuals prior to instructions and forward same to the Architect for transmittal to the Owner.

C. This Contractor shall give detailed instructions for a period of not less than 5 days, straight time, to the responsible personnel designated by the Owner in the operation and maintenance of all systems and equipment furnished under this Contract. A letter with five copies containing the name of the person or persons to whom the instructions were given and the dates of instruction period shall be submitted to the Architect/Engineer. Start-up and testing of all equipment supplied by this Contractor shall be performed by authorized factory representatives supplying equipment. Notification of this work must be given to the Owner.

D. This Contractor shall submit to the Architect/Engineer for approval four sets of operating and instruction manuals, spare parts lists, drawings, manufacturer's bulletins and other pertinent data on all equipment furnished under this Contract. Each set shall be enclosed in a suitable hard cover binder. This information must be submitted to the Owner when systems are approximately 90% complete to allow for proper review prior to final instruction.

E. Provide name, address, and telephone numbers of manufacturer's representative and service company for each piece of equipment so that service parts can be readily obtained.

F. Upon completion of instructions this Subcontractor shall provide step by step typed procedures to test and operate each piece of equipment including detailed cross referenced drawings to procedure outlined so that all equipment may be tested, shut down, turned on or bypassed by the Owner's representative.

PART 2 - MATERIALS

2.0 PIPE AND FITTINGS

A. Piping shall meet applicable ANSI or ASTM standards requirements and shall have manufacturer's name and standard marked on each length. Joints shall meet applicable ANSI and ASTM standards requirements. Where ANSI and ASTM standard does not exist, joints and fittings shall bear UL listing symbol.

B Sprinkler distribution and branch piping 2-1/2" in size and larger may be Schedule 10 black steel. Piping for sprinklers 2" and smaller in size shall be Schedule 40 black steel. .

C. Piping for use with hole-cut fittings shall have machine cut holes per manufacturer requirements at predetermined positions, on the centerline of the pipe, of a size to receive the housing locating collar.

D. Piping for use with grooved end fittings shall be roll grooved without metal removal.

E. Branch outlet fittings shall be UL listed and FM approved, rated for300 psi (MWP) on piping 2-1/2" and larger equal to Victaulic. 300 psi fittings to be used on system where working pressure is less than 175 psi.

1. Mechanical tee branch, hole-cut type connections, with locating collar engaging into hole, with standard pressure responsive gaskets and black nuts and bolts; or

2. Outlet couplings, construction as hereinafter specified for couplings, with outlets grooved or threaded outlet ends with standard pressure responsive gaskets and black bolts and nuts.

3. No strap, snap and or one bolt outlet fittings will be permitted.

F. Standard black cast iron screwed fittings shall be used on piping 2" and smaller and may be used on larger sizes.

G. All grooved couplings, fittings and mechanical tee branch fittings shall be Victaulic or approved equal.

H. Bushings shall not be permitted where fittings of required sizes are manufactured. Care shall be taken in the design of this work to avoid piping arrangements that would require bushings.

I. Unless specified otherwise herein, all fittings shall be in accordance with NFPA standards and subject to approval by the Architect/Engineer. All fittings are to be UL listed.

J. All close and shoulder nipples shall be of corresponding materials as the pipe and shall be extra heavy pattern.

K. All piping for fire mains, fire department pumper connections, and sprinkler risers shall be Schedule 40 piping with approved Victaulic joints, 300 pound class minimum fittings.

L. Regardless of size or type, fire protection contractor is responsible to supply pipe and fittings approved for the high pressures that will be developed.

2.1 HANGERS AND SUPPORTS

A. Hangers shall be NFPA approved adjustable swivel ring 2" smaller and clevis hanger 2 ½" and larger supported from structural steel or concrete floors above by approved type clamps and supports. Spacing and hanger rod size shall be as outlined in NFPA Pamphlets or as specified herein.

B. Piping at all equipment and control valves shall be supported to prevent strains or distortions in the connected equipment and control valves. Piping at equipment shall be supported to allow for removal of equipment, valves and accessories with a minimum of dismantling and without requiring additional support after these items are removed.

C. All piping installed under this section of the specification shall be independently supported from the building structure steel and concrete decks and not from the piping, wood decks, ductwork or conduit of other trades. All supplementary steel including factory fabricated channels, required to meet the requirements specified herein shall be furnished and installed by the Fire Protection contractor.

D. All vertical drops and runout pipes shall be supported by split-ring extension type hangers.

E. Pipe supports, vertical and horizontal, shall not bear on sleeves.

2.2 SPRINKLER HEADS

A. All sprinkler heads shall be listed by Underwriters' Laboratories, Inc., and approved by Owner's Insurance Underwriter. All heads shall be manufactured by a single manufacturer. All sprinkler heads to be quick response unless noted.

B. Sprinkler heads shall be provided and installed to conform with manufacturer's listing.

C. All heads within 8' - 0" of the floor in mechanical areas shall have sprinkler guards.

D. Heads shall be installed in the center of tiles.

E. Refer to sprinkler schedule on drawings.

F. In addition to the sprinkler heads actually required, furnish spare heads of each type and temperature rating used, as required by NFPA 13. Heads shall be placed in a baked enamel steel cabinet mounted as directed by the Owner. Cabinet shall contain two (2) socket wrenches and

shall be of adequate size to hold required head quantity, but not less than six (6) of each type. Provide multiple cabinets if necessary.

2.3 FIRE DEPARTMENT CONNECTIONS

A. Fire Department connections shall be Underwriters' Laboratories listed with interior self-closing clapper in each opening. Units shall be manufactured of rough brass, polished chrome plated complete with caps, plugs and chains. Threads on outlets shall conform to local Fire Department specifications. Potter Roemer #..

B. On branch line to pumper connection, provide approved straightway check valve installed in horizontal position. Piping shall be arranged to drain between check valve and siamese connection by approval ball drop connection piped to nearest drain or through wall..

C. Installation of the Fire Department connections shall be at location as shown on the drawings and/or approved by the Architect and all Authorities having jurisdiction.

2.4 VALVES

A. All valves shall be Victaulic MFG UL listed and FM approved, valves shall be rated at a minimum of 300 psi.

B. Shut-off and/or control valves shall be:

1. Outside screw and yoke valve. Cast iron body, bronze mounted, flanged ends, solid wedge, 300 psi, 2-1/2" in size and up. All bronze, 300 psi, solid wedge, threaded ends, 2" and under, all to be electrically supervised.

2. Bronze supervised slow close butterfly valve, threaded ends, stainless steel disc and stem, built-in supervisory switch, slow-close operator, up to 8" in size, 300 psi, or

3. Butterfly type indicating valves, ductile iron body, bronze disc, rubber seat, 300 psi, gear operator, with built-in supervisory switch, or
4. Pressure reducing valves shown on the drawings shall be UL listed and as manufactured by CLA-VAL Company model 90-21, or approved equal. Valve shall be rated for 300 psi with internal epoxy coating of the main valve.

C. Check valves shall be:

1. Iron body, bronze mounted swing check with flanged ends, 300 psi, 2-1/2" in size up to 8" size; or

2. Iron body, spring actuated, wafer check, 300 psi, sizes 4" through 8" UL; or

3. Grooved end, iron body, spring activated, 300 psi, sizes 2-1/2" through 6"; or

4. All check valves up to 2" in size shall be all bronze with screwed ends.

D. Trim Valves: (for use on inspectors test set ups, alarm check valves, dry pipe valves, etc.)

1. Gate valves - all bronze, 300 psi, solid wedge, outside screw and yoke, rising stem, screwed ends.

2. Ball valves - all bronze, 300 lb. WWP, screwed ends.

3. Globe valves - all bronze, 300 lb. WWP, screwed ends.

4. Check valves - all bronze swing check, rubber disc, 300 lb. WWP, screwed ends.

E. All valves that are installed as a part of this specification shall be provided with pressure ratings suitable for their intended service.

F. Test stations shall be Gem Mfg. or Victaulic Mfg. equal to Gem #F350 (TESTMASTER Assembly) sectional test and drain with 2" minimum pressure relief valve if required.

2.5 SPRINKLER ALARM BELL

A. Reliable System Sensor alarm bell, red color with appropriate labeling.

2.6 SIGNALING DEVICES

A. Valve monitor switches, sprinkler flow switches, water pressure alarm and low air pressure switches shall be furnished and installed by this Contractor, but wired by the Electrical Contractor.

1. Electrical supervisory switch locks or "tamper switches" shall be Viking, Gem, or Grinnell with two sets of double throw, single pole contacts. **No cords on switches allowed.**

2. Water flow alarm devices shall be Viking, Grinnell, or Gem, valve type, with two sets of double throw, single pole contacts and with 60 second time delay mechanism.

3. Reliable or approved equal 6" electric alarm bell for weatherproof operation.

B. The Fire Protection Subcontractor shall prepare a typewritten list of all equipment to which the Electrical Subcontractor shall make connections. This list shall include all electrical

characteristics of each piece of equipment. This is to be done to insure items that the Fire Protection Subcontractor is to provide are compatible with the building electrical requirements. Submit this list prior to purchasing any equipment.

2.7 ACCESS DOORS

A. Furnish for installation by designated Trade as determined by the General Subcontractor access doors in all locations where valves, switches or other similar equipment are installed above plaster ceilings or behind walls or anywhere they become not accessible for inspection, maintenance or servicing. Access doors shall be a minimum of 18 inch by 12 inch or shall be sized to suit the access requirement to service the equipment and shall be located individually and in a manner approved by the Architect and to meet requirements specified here and elsewhere for specific applications.

B. Doors shall be set square and flush in cooperation with the Subcontractors. Particular attention shall be exercised in the selection of doors for masonry walls in order that frame sizes used, will match the courses of brick or block. Where possible, access panels shall be located in closets, storage rooms and/or other nonpublic areas and shall be constructed in a workmanlike manner. Doors shall be positioned so that the junction can be easily reached. Where access panels are required in corridors, lobbies or other habitable areas, they will be located as directed by the Architect.

C. Doors shall be constructed of steel with primer coat of rust inhibitive paint and shall have continuous piano hinge, as manufactured by Inland Steel Products Milcor, Miami, Walsh-Hannon or approved equal. Doors shall be key operated with flush operated cylinders, keyed alike. Key lock system shall be coordinated with the Hospital and shall be as approved by the Architect. Provide six (6) keys of type used for access panels for Owner's use. Obtain receipt of key delivery and submit to Architect for record.

1. Masonry non-rated walls Style "M" with 16 gauge frame and 14 gauge panel.

2. Masonry fire rated walls Fire Rated with FM and UL, 2 hour "B" rating, 16 gauge frame, 20 gauge sandwich type insulated panel.

3. Suspended lath and plaster ceilings Style "K" with 16 gauge frame, 14 gauge panel.

4. For access panels larger than 16 inches in either direction, provide two (2) locksets.

2.8 MAIN ALARM CHECK

A. Reliable Model E-6" alarm check valve with associated trim as shown on drawing. Valve to be rated for 300 psi working system pressure.

1. Wet alarm valve shall be UL listed and FMG approved for a wet pipe sprinkler system, complete with ductile iron body, flanged or grooved outlet, main drain valve, pressure gauges, alarm port, external bypass, hand hole with cover, hinged clapper assembly and

other required trimmings. Valve shall be equal to Reliable Model E, Victaulic, Grinnel or Viking for variable pressure vertical installation with water motor and chrome plated gong. Water motor and gong shall be located on the outside of building. Supply pipe to gong and drain shall be IPS brass, galvanized steel or copper.

2. Excess pressure kit to be Gamewell #26615-7 with associated control wiring, pressure switches, supervisory panel, mounting brackets, pump and motor. Motor shall operate from differential pressure switch. Furnish with alarm lights and alarm dry contacts. Pump capacity: 1 GPM, 175 psi max, 1/4 HP, 120V.

3. Valve trim shall include pressure activated electric alarm switch.

2.9 SEISMIC BRACING

A. The Fire Protection Subcontractor shall provide all necessary design and materials for seismic restraint and protection of piping and devices against damage where subject to earthquakes as required for the entire plumbing system within the building. All isolation and seismic devices shall be the product of a single manufacturer. Products of other manufacturers are acceptable provided their systems strictly comply with this section of the specifications. Provide isolation materials and seismic restraints complete and as manufactured by Mason Industries, Tolco or approved equal.

B. The work under this section shall include the design, furnishing and installation of all restraint devices and systems as may be required for the fire protection system including, but not necessarily limited to, the following:

1. All fire protection equipment and devices.
2. All fire protection system piping as required.
3. Piping penetrations through floors and walls.
4. Sleeves with clearances around the outside, as recommended.
5. Equipment isolation bases.
6. Piping flexible connectors.
7. Seismic restraints for isolated equipment.
8. Seismic restraints for non-isolated equipment.
9. Certification of seismic restraint designs.

C. Submit ten (10) copies of descriptive data for all products and materials, including the following:

1. Catalog cuts and data sheets for the specific isolators, restraints and all other items to be utilized.
2. Details of methods of sleeving, fire protection smokeproofing and isolation for pipes penetrating walls and slabs.
3. Specific details of seismic restraints and anchors, including number, size and locations for each piece of equipment.

4. Calculations to support seismic restraint designs.
5. All calculations, details and other submittal materials shall be sealed and signed by a structural or civil engineer registered in the state and qualified to perform seismic design calculations.
6. A seismic design liability insurance certificate that must accompany all submittals.

D. Code and standards requirements shall include, but not be limited to:

1. Applicable IBC with any additional State or Local requirements.
2. NFPA 13 and 24 and other applicable NFPA standards.
3. All State and Local codes.

E. Manufacturers working in this section must provide a seismic design liability insurance certificate and certify their ability to provide engineering and design as required by this section. This certificate shall be submitted to the architect for review prior to any submittals.

1. Manufacturer's Listed and Approved Design Manual

2.10 BUILDING AUTOMATION SYSTEM

The building automation system (BAS) shall be furnished and installed under another Section. The Fire Protection Contractor shall provide dual contact pressure switches, tamper switches, flow switches, tees, pipe wells, valve caps and/or additional contacts at equipment control/alarm panels to allow the connection from the BAS system to the piping and/or equipment where required. The following table itemizes the equipment, location and type of alarm or contact point and condition necessary to connect to the BAS system.

PIPE OR EQUIPMENT	TYPE OF ALARM, CONTACT POINT OR CONDITION WHICH SHALL BE MONITORED BY BAS	CONTROL	LOCATION
Main Alarm Check Valve	Open	Pressure Switch	Sprinkler Room – Basement Floor Level
Fire Protection Supply	Low Pressure	Pressure Switch	Sprinkler Room – Basement Floor Level

2.11 ELECTRICAL CONTROL AND INTERLOCKING WIRING

A. The electrical contractor shall furnish and install power wiring 480/208 volt, 120 volt connection only to all Fire Protection connected equipment including panels and motors. This Fire Protection subcontractor shall mount panels and shall furnish and install all control and interlocking wiring for each piece of Fire Protection equipment including but not limited to remote alarms and local alarms for all Fire Protection and equipment, alarms, pressure switches, flow switches and solenoid valves. All control wiring and interlocking wiring shall be installed in conduit and in accordance with the respective manufacturer's requirements and all connections shall be provided by the fire protection subcontractor. Wiring and conduit provided by this subcontractor shall be installed in accordance with the requirements of SECTION 16000 of the specifications.

B. All electrical panels and life support panels shall be equipped with connection for emergency power hook-up.

2.12 DOUBLE CHECK VALVE ASSEMBLY

A. Double check valve assembly on fire protection water service shall be Watts Model 709 double check assembly or FEBCO with FDA approved epoxy coated cast iron check valve bodies with bronze seats, bronze bodied ball valve test cocks, U.L., FM approved outside stem and yoke gate valve shut-offs, repair kit, test kit and pressure gauges. Valve assembly shall be mounted in accordance with City and State Requirements and properly secured to the wall or floor stand mounted. Assembly shall be tested and certified under AWWA std. No. C506 and FCCCHR of USC manual, Section 10 and listed by U.L.

2.13 DUCTILE IRON PIPE AND FITTINGS – FIRE SERVICES

A. Thickness Class 52 cement lined ductile iron pipe conforming to AWWA C151-7, flanged ends.

B. Fittings shall be ductile iron, cement lined, 250 psi rating, flanged ends.

C. Shall be used for Fire Protection water services outside of building. Shall be used for Fire Protection service within building up to 6” DSCV assembly.

PART 3 - INSTALLATION

3.1 GENERAL

A. The contract drawings intend to show only the scope of the design, the fire protection subcontractor shall be responsible for the correct installation of this work in a manner satisfactory to the best practices of his trade to complete the scope of this subcontract in all respects. All roughing to equipment shall be accomplished in all details to Specifications of equipment manufacturer and to approval of Architect. No roughing work shall be accomplished until the pertinent manufacturer's shop drawings are approved.

B. The location of piping as indicated on the Drawings, unless otherwise noted, is diagrammatic only, and the exact locations shall be determined in the field. The run and arrangement of all pipes shall be approximately as shown on the Drawings, as directed during installation, in strict accordance with NFPA Pamphlets, and as straight and direct as possible, forming right angles or parallel lines with building walls and other pipes, and neatly spaced. All risers and standpipes shall be erected true and plumb, parallel with walls and other pipes, and neatly spaced. All horizontal runs of piping, except where concealed in partitions, shall be kept as high as possible and close to walls. All piping shall be concealed and concealed piping shall have a minimum number of fittings. Piping shall not interfere with the operation or accessibility of doors, windows, access panels, valves, H&V unit access, air flow patterns, or equipment, and shall not encroach on aisles or passageways. All piping shall be installed to preserve access to all valves, drains and equipment. Pipe will not be permitted to pass through footing, beams or ribs. Make such offsets and deviations from the Drawings as may become necessary to meet actual field conditions.

C. The Fire Protection Subcontractor shall be responsible for the correctness of field dimensions and shall check for himself all grades, lines, measurements, and other data in any way effecting his work. He shall refer to the project phasing schedule together with architectural and structural drawings of other trades for a full comprehension of the extent of the work to be performed and to avoid interference, and shall not be entitled to any extra compensation for any additional work or expense arising from his failure to do so. In case interference develops the Architect shall decide which work is to be relocated, regardless of which was first installed. Work installed by the fire protection subcontractor which is improperly located and/or interferes with or modifies either the phasing schedule or the architectural or structural design, shall be changed as directed by the Architect, and all costs incidental to such changes shall be paid by the fire protection subcontractor.

D. The fire protection subcontractor shall coordinate all his work with the work of all other trades, and shall so arrange his work that there will be no delay in the proper installation and completion of any part or parts of each respective work wherein it may be interrelated with his, so that generally all construction work can proceed in its natural sequence without unnecessary delay, close coordination is also required with the HVAC, plumbing and electrical subcontractors in areas serving these trades.

E. Contact between piping and dissimilar metals such as hangers, building structural work, or equipment shall be avoided to prevent galvanic action.

F. Pipe shall be cut accurately to measurements established at the site and shall be worked into place without springing or forcing. All pipe, regardless of how cut throughout the job, shall be reamed smooth and all burrs removed before being installed. Pipe shall not be split, bent, flattened, nor otherwise injured either before or during the installation. Full lengths of pipes shall be used wherever possible and short lengths of pipe connected with couplings will not be permitted.

G. The Fire Protection Subcontractor shall use every precaution in the installation of all piping to prevent dirt, chips, or other foreign materials entering the inside of piping. All pipes shall be clean and blown out to the satisfaction of the Architect before closing of any line. Keep the ends of piping capped or blind flanged during the construction of the system to keep out dirt or other foreign matter. The plugs and caps are to remain until permanent and final installation is made. The use of paper, waste, rags and so forth to close openings will not be permitted.

H. Unions or flanges shall be installed at all equipment valves and at such other places as may be necessary to disconnect piping or at each piece of equipment or accessory which may have to be disconnected to make repairs.

I. Bushing will not be inserted in fittings for reduction in size where fittings of required size are manufactured.

J. The Fire Protection Subcontractor shall also provide the necessary data and supervision for the provision of all holes in the structure, and also for the installation of equipment foundations, including bolt hole templates, weights and manufacturer's recommendations for proper emplacement design. This shall be furnished to the General Contractor and other related subtrades.

K. Equipment and accessories shall be set level, plumb and in proper alignment with reference to adjacent walls. All surfaces coming in contact with walls, floors or other equipment shall have properly planed surfaces with suitable contact on wall and floors.

L. Sprinkler heads shall be located in centers of tile.

M. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible, before start of spray fiber work. Piping and equipment that interfere with proper application of fireproofing shall be installed after completion of spray fiber work. Patch and repair spray fireproofing cut or damaged during course of work specified under this Section. Trade responsible for damage shall bear cost of repair.

3.2 INSTALLATION REQUIREMENTS

A. Subcontractor shall comply with all the rules, Codes, Ordinances, regulations and requirements, of all legally constituted Authorities Having Jurisdiction over the whole or any part of the work herein specified. These requirements are minimum criteria and no reductions permitted by Code will be allowed without written permission of the Architect.

B. All equipment and materials furnished in connection with the installation shall be new and furnished in accordance with the requirements of this specification and they shall be of the best grade and quality of their respective kinds, free from natural, manufacturing or construction flaws, defects or irregularities and finish, fittings and workmanship shall be equal to the highest commercial grade.

C. Castings of all metals, of all kinds, shall be clean, smooth, close grained, of uniform thickness and free from all defects such as sandholes, blisters or cracks.

D. Before the installation will be accepted, Subcontractor shall have every portion of his work in a first-class working condition.

E. Where planning the installation of any of the apparatus herein called for, sufficient clearance shall be allowed to permit the removal and replacing of parts that may require future removal for repairs and replacement.

3.3 TEMPORARY STANDPIPE SYSTEMS

A. All standpipe risers shall continue up through the floors and temporary hose, nozzles and valves provided as required as the floors are erected for fire protection during construction. Standpipes shall be supplied through a temporary siamese inlet at grade located where directed by the Fire Department. Access to temporary siamese inlet connection shall be kept clear and accessible at all times. It shall be the responsibility of this Subcontractor to insure this temporary fire protection supply be available at all times. All valves shall be properly adjusted for the maximum pressure setting allowable as required and a typewritten report of such tests and adjustments shall be submitted to the Architect/Engineer.

3.4 IDENTIFICATION

A. All labeling of piping, materials and equipment, as outlined hereinafter for identification purposes, shall be performed by this Contractor.

B. Piping systems shall be identified with approved snap-on covers designating services and direction of flow. Location of identification covers shall be near access panels wherever possible and on both sides of valves. The markers shall be as manufactured by WH Brady Co., Westline Products, Seton Name Plate Co., or approved equal.

C. Before the snap-on labels are applied, piping shall be thoroughly cleaned and painted, if specified.

D. Letters shall not be less than 1-1/2" in height. Arrows shall not be less than 9" long. Identification shall be installed on pipes above hung ceiling and furred spaces.

E. All systems shall be identified at intervals of approximately 20' change of direction and on both sides of wall where pipes pass through walls.

3.5 TESTING AND INSPECTION

A. This Contractor shall obtain and pay for all the inspection and tests required for this Section of the work. Defects discovered in work, materials and/or equipment shall be replaced at no cost to the Owner, and the inspection and test shall be repeated. When work is completed, this Contractor shall furnish a Certificate of Inspection and Approval to the Owner before final payment of the Contract will be allowed.

B. Test sprinkler piping and make watertight before concealment. Make partial tests as required, during the progress of the work. All tests shall be witnessed by the Owner's representative, Authorities Having Jurisdiction and a representative of the Engineer.

C. Sprinkler system shall be tested to a hydrostatic test of 400 psi for two (2) hours in accordance with NFPA as a minimum testing requirement.

D. This Subcontractor shall, with the parties noted herein, establish procedures to witness testing that are acceptable to the parties noted herein. All parties noted herein shall be notified in writing of the accepted testing procedure prior to any testing. This Subcontractor shall notify parties designated to witness testing at least 48 hours in advance of scheduled testing.

E. Conditions requiring testing in excess of the minimum requirements noted herein shall be performed in accordance with NFPA standards and any requirements of Authorities Having Jurisdiction.

F. Should the Owner, Architect, Engineer or any Authority Having Jurisdiction require, this Subcontractor shall provide factory trained, manufacturer's authorized representatives to perform testing on any equipment and/or devices that may be an integral part of this specification.

G. Dispose of test water and wastes after tests are complete, in a manner satisfactory to the Architect.

H. Furnish to the Architect/Engineer completely executed test certificates with signatures of those required to witness testing. Test certificate forms shall follow NFPA formats as a minimum requirement.

I. All electrical alarm devices are to be tested and adjusted in conjunction with the Electrical and/or Fire Alarm Subcontractors. Testing or retesting and adjustment of these devices shall be at no additional cost to the Owner. Testing and adjustment shall be as required until these devices are performing as an integral part of the total alarm system as specified for that part of the work.

3.6 CLEANING OF SYSTEMS

A. Before the Fire Protection Systems are accepted, all equipment shall be thoroughly cleaned to remove all dust, dirt, and/or other foreign matter which may be detrimental to the operation of the Systems or building finishes.

B. After the installation is complete, equipment with factory finished surfaces shall be cleaned. Damaged or scratched spots shall be touched up with the same type and color paint as applied at the Factory.

C. All equipment that is to receive finish paint by the Painting Contractor shall be cleaned by this Contractor and left ready to have surfaces prepared to receive paint.

3.7 EQUIPMENT ACCESS REQUIREMENTS

A. All work shall be installed so that all parts requiring inspection, operation, maintenance and repair are readily accessible. Minor deviations from the Drawing may be made to accomplish this, but changes of magnitude shall not be made prior to written approval from the Architect.

B. Furnish access panels if required in walls and ceilings as required to permit access for adjustment, removal and the replacement and servicing of all equipment, and all other items requiring maintenance and adjustments. Access panels shall be installed by the General Contractor or respective Subcontractor.

3.8 SIGNS

A. Signs and nameplates in accordance with NFPA standards and/or this specification shall be provided at all drains, test and alarm valves and other areas as required by NFPA Standards.

3.9 MATERIALS AND EQUIPMENT HANDLING

A. Refer to Section 01600 of Division 1 - General Requirements for the requirements of this Section.

3.10 CLEANUP

A. After completion of the work, all tools and other equipment shall be removed from the building. All excess materials shall be removed and the building left broom clean. All cabinets, valves, and equipment shall be cleaned and polished.

B. This Contractor shall clean, patch and repair any material and finish of the building or its contents damaged during the execution of this Contract.

3.11 PROJECT CLOSE-OUT

A. In order to closeout the project the contractor must submit to the Owner (3) binders that include copies of the following:

1. Inspectional services sprinkler permit to install Fire Protective Systems.

2. Portland Fire Department permit to install a fire extinguishing system: 14:02.

3. Contractor's material and test certificate for above ground piping for Automatic Sprinkler Systems (NFPA 13).

4. Tamper and Flow Alarms; Certificate of Completion NFPA 72. To be provided by electrical Subcontractor or alarm service company.

5. A copy of an affidavit from the Architect or Engineer, of record, whose competency is consistent with the registration laws and regulations of The State of Maine. The affidavit shall indicate that he or she has made on-site visits and that the work has been completed satisfactorily as required.

END OF SECTION

SECTION 15300 - FIRE PROTECTION

PART 1 – GENERAL

1.1 REFERENCES

A. All of the Contract Documents, including General and any Supplementary Conditions and Division 1-General Requirements, apply to the work of this section.

B. Examine all Drawings and all other Sections of the specifications for requirements therein affecting the work of this trade.

C. The fire suppression system drawings and hydraulic calculations that are a part of these fire protection documents have been developed and prepared for use in complying with permitting requirements. The installing contractor shall be responsible to prepare shop drawings hydraulic calculations, providing design narrative and to provide all other documentation required to be submitted for review by any Authority Having Jurisdiction, the architect and Registered Professional Engineer that has sealed and signed these documents.

D. This specification requires preparation and submissions of drawings and other documents, procurement of approvals and provision of a complete functional systems of automatic fire protection. As a result, this Section serves dual purposes of providing specifications and indicating design criteria for the Fire Protection Subcontractors use and guidance in preparing sprinkler installation drawings and other documents for approvals.

E. The fire protection work is partially shown on the drawings. Each bidder for work under this Section of the specifications shall establish for himself, the exact quantity of heads and all other materials and equipment required for the project and the exact extent of the work required for the project and the exact extend of the work required by all Authorities Having Jurisdiction. Refer to Architectural reflected ceiling plans for sprinkler head locations. Additional heads shall be provided at no additional cost as part of this Contract, as required, to satisfy the Code requirements.

1.2 DEFINITIONS

A. Words in the singular shall also mean and include the plural, wherever the context so indicates and words in the plural shall mean the singular, wherever the context so indicates.

B. Wherever the terms "shown on drawings" are used in the specifications, they shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.

C. Wherever the term "provide" is used in the specifications it will mean "furnish" and "install", "connect", "apply", "erect", "construct", or similar terms, unless otherwise indicated in the specifications.

D. Wherever the term "material" is used in the specifications it will mean any "product", "equipment", "device", "assembly", or "item" required under the Contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.

E. The terms "approved", or "approval" shall mean the written approval of the Architect.

F. The term "specification" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, including all drawings.

G. The terms "directed", "required", "permitted", "ordered", "designated", "prescribed" and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect. The terms "approved", "acceptable", "satisfactory" and similar words shall mean approved by, acceptable or satisfactory to the Architect. The terms "necessary", "responsible", "proper", "correct" and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.

H. "Piping" includes in addition to pipe or mains, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

I. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.

J. "Exposed" means not installed underground or "concealed" as defined above.

K. "Fire Protection Subcontractor" refers to the Subcontractor or his Subcontractors responsible for furnishing and installation of all work indicated in the Fire Protection specifications and as shown on the fire protection drawings.

L. Owners Insurance Underwriter

1.3 SCOPE

A. Perform work and provide material and equipment as shown on the Fire Protection Drawings and as specified or indicated in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide a complete and fully functional installation.

B. Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

C. Give notices, file plans, obtain permits and licenses, pay fees and obtain necessary approvals from all Authorities Have Jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings and Addenda all of which are part of these Contract Documents.

D. The Scope of the Work consists of the installation of all materials to be furnished under this Section, including all associated work required, and without limiting the generality thereof, to include:

Hydrant flow testing.
Complete automatic sprinkler system including main alarm check valve.
Automatic sprinkler heads (including all heads to be center of tile).
Inspector's test stations, connections and drain risers.
Fire department connections.
Temporary standpipes and fire department valves for emergency use during construction.
Supervisory (Tamper) switches.
Flow switches.
Escutcheons.
Coordination and co-operation.
Catalog cuts, shop drawings and hydraulic calculations verifying pipe sizing.
Connection to new Fire Service 10’-0” beyond building wall.
Double check valve assembly
Core drilling of holes up to and including 12" diameter
Sleeves, caulking and fireproofing of sleeves, inserts and hangers
Staging and planking up to and including 8 feet in height
Testing and certificates
Record drawings - AutoCAD 2010
Operations and Maintenance manuals
Valve tags and charts
Instructions
Spare heads in cabinet, wrenches
Hoisting, rigging, setting of all piping and equipment as outlined in General Conditions
Fees, permits, royalties, guarantees, submittals to and approvals from City of New Haven Fire Department and Owner's Insurance Agent and all other State and Local Authorities exercising jurisdiction over this project.
Pressure gauges at top of each riser
Furnishing of access panels
Drains
Coordination drawings - AutoCAD 2010
Seismic Bracing
Building automation system
Expansion loops
Control and Interlocking wiring
Vibration Isolators

E. The following work is not included in this Section and is to be performed under other Sections:

1. Cutting and patching.
2. Temporary water, facilities and controls.
3. Housekeeping pads, thrust blocks for exterior piping, cutting and patching in concrete:
4. Flashing of all pipe penetrations.
5. Finish painting.
6. Plumbing
7. Heating, ventilating and air conditioning work
8. Electrical power wiring, wiring of tamper and alarm flow switches to building fire alarm system.
9. Installation of access panels furnished under this Section shall be by the Trades as designated by the Construction Manager.
10. Painting, except as specified herein.
11. Electric power wiring only for all equipment.
12. Temporary light, power, water, heat, gas and sanitary facilities for use during construction and testing.
13. Sprinkler waste outlet.
14. Fire alarm system and controls.

1.4 CODES, STANDARDS AND REFERENCES

A. All materials and workmanship shall comply with all latest editions of applicable Codes, Local and State Requirements and requirements of all Authorities having jurisdiction, and these specifications.

B. In case of difference between any Regulations and the Contract Documents, the Fire Protection Subcontractor shall promptly notify the Architect in writing of any such difference.

C. In case of conflict between the Contract Documents and the requirements of any Code or requirements of any Authorities Having Jurisdiction, the most stringent requirements of the aforementioned shall govern. Fire Protection Subcontractor shall promptly notify the Architect in writing of any such occurrence.

D. Should the Fire Protection Subcontractor perform any work that does not comply with the requirements of the specifications and applicable Codes, he shall bear all costs arising in correcting the deficiencies to the satisfaction of the Architect.

E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations and the applicable requirements of the following accepted Codes and Standards, without limiting the number, as follows:

1. Local and state building, plumbing, mechanical, electrical, fire and health department codes.
2. National Fire Protection Association (NFPA)
3. Occupational Safety and Health Act (OSHA)
4. Building Owner’s Insurance Company
5. Underwriters' Laboratories (UL)
6. International Building Code (IBC)

F. In these specifications, references made to Code are intended to indicate the accepted volume or publication of the Standard or applicable Code. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:

1. ANSI American National Standards Institute
2. ASME American Society of Mechanical Engineers
3. ASTM American Society of Testing Materials
4. AWS American Welding Society
5. CS Commercial Standards, U.S. Department of Commerce
6. MSS Manufacturers Standardization Society of the Valve and Fittings Industry
7. NEMA National Electrical Manufacturers Association
8. UL Underwriters' Laboratories, Inc.

G. Specific reference is made to the following NFPA codes which shall govern provision of work as specified and as required by codes and authorities.

1. No. 13 Installation of Sprinkler Systems
2. No. 25 Inspection, Testing, and maintenance of water based Fire Protection Systems
3. No. 72 National Fire Alarm Code
4. No. 101 Life Safety Code

H. The Fire Protection Subcontractor for the work shall give all necessary notices, obtain and pay for all permits, pay all taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. The Fire Protection Subcontractor shall obtain all required Certificates of Inspection for his work and deliver same to the Architect before request for acceptance of his portion of work is made and before final payment.

1.5 GUARANTEE

A. Attention is directed to provisions of the General Conditions and Supplementary General Conditions regarding guarantees and warranties for work under this Contract.

B. Manufacturers shall provide their standard guarantees for work under this Contract. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and Construction Manager may have by Law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the Fire Protection systems, as determined by the Architect and shall remain in effect for a period of one (1) year thereafter.

C. All materials, items of equipment and workmanship furnished under each Section shall carry the standard warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the Fire Protection Subcontractor including all other damage done to areas, materials and other systems resulting from this failure.

D. The Fire Protection Subcontractor shall guarantee that all elements of the systems provided under his Contract, are sufficient to meet the specified performance requirements as set forth herein or as indicated.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the Fire Protection Subcontractor within one (1) week at no cost to the Owner.

F. The Fire Protection Subcontractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

G. Provide 24 hour service beginning on the date the project is first occupied, whether or not fully occupied, and lasting until the termination of the guarantee period. Service shall be at not cost to the Owner. Submit name and a phone number that will be answered on a 24 hour basis each day of the week, for the duration of the service.

H. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's satisfaction, advise Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Architect will suggest course of action.

1.6 THE SUBCONTRACTOR

A. The Fire Protection Subcontractor shall study all Contract Documents included under this Contract to determine exactly the extent of work provided under this Section, and in installing new equipment and systems and coordinating the work with the other Trades.

B. The Fire Protection Subcontractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications.

C. The Fire Protection Subcontractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed

directly or indirectly by the Fire Protection Subcontractor shall perform their work according to all the conditions as set forth in these specifications.

D. The Fire Protection Subcontractor shall furnish all materials and do all work in accordance with these specifications and any supplementary documents provided by the Architect. The work shall include every item shown on the drawings and/or required by the specifications as interpreted by the Architect. All work and materials furnished and installed shall be new and of the best quality and workmanship. The Fire Protection Subcontractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed.

1.7 COORDINATION OF WORK

A. The Fire Protection Subcontractor shall compare his drawings and specifications with those of other Trades and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the mechanical work. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, Fire Protection Subcontractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the Fire Protection work caused by the Fire Protection Subcontractor's neglect, shall be made by him at his own expense, to the Architect's satisfaction.

B. Locations of pipes and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. The Fire Protection Subcontractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component.

C. Lines which pitch shall have the right-of-way over those which do not pitch. For example, waste piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.

D. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The Fire Protection Subcontractor shall provide manual air vents and drains as required for his work to effect these offsets, transitions and changes in direction. All work shall be installed in a way to permit removal (without damage to other parts) of coils, filters, control appurtenances, fan shafts and wheels, filters, belt guards, sheaves and drives and all other system components provided under this Contract requiring periodic replacement or maintenance. All piping shall be arranged in a manner to clear the openings of swinging overhead access doors as well as ceiling tiles.

E. The Contract Drawings are diagrammatic only intending to show general runs and locations of piping, equipment, and specialties and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other

Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom. All changes required due to job conditions must be approved by the Architect prior to commencement of work.

F. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, flow switches, etc., such conflicts shall be reported to the Architect prior to signing of the Contract. If such action is not taken, the Fire Protection Subcontractor shall furnish such items as part of his work as necessary, for complete and operable systems and equipment, as determined by the Architect.

G. Where drawing details, plans and/or specification requirements are in conflict and where pipe sizes of same pipe run is shown to be different between plans and/or between plans and sections or details, the most stringent requirement will be included in the Contract. Fire Protection systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.

H. Final location of all sprinkler heads, alarms, control devices shall be coordinated with the Architectural reflected ceiling plans and/or other Architectural details, as applicable. Offsets of piping, added sprinkler heads, elbows, etc., shall be provided as required to comply with the architectural reflected ceiling plans. Obtain approval of locations of all devices from Architect in the field. Additional heads, piping, fittings, etc., shall be provided to accomplish the above requirement, as required, all as part of this Contract, at no extra cost to the Owner.

I. Included as part of coordination, this fire protection contractor shall maintain service and maintenance access around all fire protection equipment.

1.8 COORDINATION DRAWINGS

A. Before materials are purchased, fabricated or work is begun, each Subcontractor shall prepare coordination drawings for all floors/areas, including buried systems/services (all-Trade-composite at 3/8 inch scale), showing the size and location of his equipment and lines, in the manner described herein under General Requirements - Section 01040.

B. Coordination drawings are for the architect’s use during construction and shall not be construed as shop drawings or as replacing and shop drawings. The coordination drawings, when corrected for actual “as-built” conditions, will be reviewed by the Architect, corrected and become the Record Drawings to be submitted to the Owner for his use.

C. The cost of producing and reproducing the drawings will be included under the Contract of each Trade, including the cost or preparation of the Architectural building outlines. The HVAC

Contractor shall take the lead to produce the Architectural backgrounds, show all ductwork, piping, etc., and circulate the drawings to any of his Subcontractors and the other Trades (Plumbing, Fire Protection, Electrical), so that they can indicate all their work as directed by the Architect as required, to result in a fully coordinated installation.

D. In addition to the regular coordination drawing review, the mechanical work will also be reviewed by the Architect/Engineer to ensure that the system and equipment arrangements are suitable to provide maintenance access and service as follows:

1. Valves and instrumentation should be grouped where possible and positioned in accessible locations.

E. Prepare a complete set of computer based AutoCad 2005 drawings at scale not less than 3/8" equals 1'-0", showing basic layout for the structure and other information as needed for preparation of Coordination Drawings. The drawings shall indicate the layout of all specialty tradework as indicated herein and shall be designated as Coordination Drawings. The Contractors can purchase a copy of the floor plans on disk from the engineer to assist in the preparation of Coordination Drawings. The Contractor shall provide a minimum of two (2) weeks notice to the engineer for the preparation of the disk. A signed liability release form will be required from the Contractor prior to the release of the disk from the engineer.

F. Highlight all fire rated partitions on the Coordination Drawings for appropriate coordination.

G. The main paths for the installation or removal of equipment from mechanical and electrical rooms shall be clearly indicated on the Coordination Drawings.

H. Each of the specialty trades shall add its work to the base drawings with appropriate elevations and grid dimensions. Specialty trade information shall be required for fan rooms and mechanical rooms, horizontal exits from duct shafts, crossovers and for spaces in the above ceilings where congestion of work may occur such as corridors and, where required, entire floors. Drawings shall indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions and other services. Indicate elevations relative to finish floor for bottom of ductwork and piping and conduit 6" greater in diameter.

1. Specialty Trade shall include:

a. Plumbing system.
b. HVAC piping and equipment
c. Electrical
d. Sheet Metal Work
e. Sprinkler System
f. ATC system

I. Upon completing their portion of the Coordination Drawings, each specialty trade shall sign, date and return Coordination Drawings to the Contractor.

J. Where conflicts occur with placement of materials of various trades, the General Contractor shall be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialized and dated by the affected specialty trade subcontractor. The General Contractor shall then final date and sign each drawing.

K. Fabrication shall not start until Coordinate Drawings have been distributed to all parties as indicated herein.

L. Format: Coordination Drawings (plans only) shall be done using CAD in AutoCAD, 2005 in either IBM or Mac Format, disks shall be given to the architect for future transfer to Owner. Coordination Drawings will be used as base for as-built drawings.

M. Distribution of Coordination Drawings:

1. The General Contractor shall provide one print of each Coordination Drawing to:

    a. Each specialty trade Subcontractor
    b. Owner
    c. Construction Manager
    d. Architect (for record purposes)

N. After distribution:

1. The method used to resolve interferences not previously identified shall be as in paragraph F. above. Distribute revised Coordination Drawings to all parties listed above.

O. Coordination Drawings include but are not necessarily limited to:

1. Structure
2. Partition/room layout, including indication of smoke and fire resistance rated partitions.
3. Ceiling layout and heights
4. Light fixtures.
5. Access Panels
6. Sheet metal, heating cols, boxes, grilles, diffusers, etc.
7. All heating piping and valves.
8. Smoke and fire dampers.
9. Soil, waste and vent piping.
10. Major water and gases.
11. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit. Motor control centers, starters and disconnects.

12. Sprinkler piping and heads.
13. All equipment, including items in the Contract as well as O.F.C.I. and O.F.I. items.
14. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur indicates areas in which the required access area may be greater than the suspected grid systems.
15. Dental Vacuum & Dental Air System

1.9 GIVING INFORMATION

A. The Fire Protection Subcontractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the Architect and other Subcontractors sufficiently in advance of the work so that all openings may be built in advance.

1.10 EQUIPMENT AND MATERIALS

A. Equipment and materials shall be delivered to the site and stored in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls, switches, etc., shall be stored in dry, heated spaces.

B. The Fire Protection Subcontractor shall have his equipment tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned, polished thoroughly and turned over the Owner in a condition satisfactory to the Architect. Damage or defects developing before acceptance of the work shall be made good at the Fire Protection Subcontractor's expense.

C. The Fire Protection Subcontractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.

D. The manufacturers listed within this specification have been pre-selected for use on this project. No submittal will be accepted from a manufacturer other than specified. Should the Fire Protection Subcontractor wish to propose a substitution during the bid period, such request shall be made in writing to the Architect, no less than seven (7) working days, prior to bid date. If substitutions are deemed acceptable, such items shall be issued on an Addendum, prior to bid due date. The above requirement is mandatory.

E. Manufacturers' directions shall be followed completely in the delivery, storage, protection and installation of any equipment. Promptly notify the Architect in writing of any conflict between

any requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's written instructions before proceeding with the work. Should the Fire Protection Subcontractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.

F. The Fire Protection Subcontractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.

G. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of the Fire Protection Subcontractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, the Fire Protection Subcontractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Fire Protection Subcontractor shall make all necessary changes in all affected related work provided under other Sections including location of roughing in connections by other Trades, electrical requirements, piping, supports, insulation, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.

H. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. Equipment and materials shall be products which will meet with the acceptance of the Authorities having jurisdiction over the work and as specified hereinbefore. Where such acceptance is contingent upon having the products listed or labeled by FM, UL or other testing laboratories, the products shall be so listed or labeled. Where no specific indication as to the type or quality of material or equipment is indicated, a first class standard article shall be provided.

I. All equipment of one type (such as valves, heads, switches, etc.,) shall be the product of one manufacturer, unless otherwise specified.

1.11 CUTTING AND PATCHING

A. All concrete and masonry equipment bases and pads, curbs, chases, pockets and openings required for the proper installation of the work under this Contract will be provided by the General Contractor, using information, as shown on the drawings and/or as required and furnished by the Fire Protection Subcontractor. At a minimum, concrete bases (housekeeping) pads shall be 4 inches high and extending 3 inches on all sides beyond equipment (for all base mounted equipment).

B. In addition to the requirements outlined herein for cutting and patching, the Fire Protection Subcontractor shall be responsible for core drilling all holes required for work under his Contract and with the written approval of the Architect.

C. In no case shall the Fire Protection Subcontractor cut into any structural elements without the written approval of the Architect.

1.12 USE OF PREMISES

A. The Fire Protection Subcontractor shall confine all of his apparatus and storage of materials and construction to the work area or limits as directed by the Architect and he shall not encumber the premises with his materials.

B. In storing materials within areas (structure or ground), or when used as a shop, the Fire Protection Subcontractor shall consult with the Construction Manager and shall restrict his storage to space designated for such purposes. The Fire Protection Subcontractor will be held responsible for repairs, patching or cleaning arising from any unauthorized use of premises.

C. Notwithstanding any approvals or instructions which must be obtained by the Fire Protection Subcontractor from the Architect in connection with use of premises, the responsibility for the safe working conditions at the site shall remain the Fire Protection Subcontractor's and the Architect or Owner shall not be deemed to have any responsibility or liability in connection therewith.

1.13 PROTECTION

A. All materials such as valves, fittings, piping etc., shall be properly protected and all piping openings shall be temporarily closed by the Fire Protection Subcontractor installing same, so to prevent obstruction and damage. To protect the equipment, temporary covers of substantial nature shall be provided to assure that items such as fire department valves, cabinets, etc., are not damaged. The Fire Protection Subcontractor shall take precautions to protect his materials from damage and theft.

B. The Fire Protection Subcontractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or systems provided under his Contract.

1.14 DAMAGE TO OTHER WORK, CORRECTION OF WORK AND EXTRA WORK

A. The Fire Protection Subcontractor shall be held responsible and shall pay for all damages caused by his work to the building structure, equipment, piping, duct systems, etc., and all work and finishes installed under this Contract in the building. Repair of such damage shall be done as herein before specified, at the expense of the Fire Protection Subcontractor and to the Architect's satisfaction.

B. The Fire Protection Subcontractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after completion of work and whether or not fabricated, installed or

completed. The Fire Protection Subcontractor shall bear all costs of correcting such rejected work.

C. No claim for extra work will be allowed unless it is authorized by the Architect in writing before commencement of the extra said work.

1.15 PIPE SLEEVES, PLATES AND ESCUTCHEONS, FIRE STOPPING AND SMOKEPROOFING

A. Where pipes pass through all walls or floors, the Fire Protection Subcontractor shall provide and set individual sleeves for each pipe and all other work under his charge, as necessary for passage of all pipes. Sleeves shall be of sufficient size to provide 1/2 inch air space around the pipe passing through it. All openings shall be sealed, smokeproofed and made tight. The Fire Protection Subcontractor shall be responsible for the exact location of sleeves provided under this Contract and shall coordinate all requirements for piping sleeves.

B. The Fire Protection Subcontractor, for work under his charge, shall determine the diameter of each individual wall opening or sleeve before ordering, fabrication or installation.

C. Sleeves and inserts shall not be used in any portions of the building, where their use would impair the strength or construction features of the building. Elimination of sleeves must be approved by the Architect.

D. Provide chrome-plated brass escutcheons with set screw for exposed piping, in all areas. In mechanical rooms use plain brass or cast iron escutcheons suitable for painting. All escutcheons shall be sized to fit the bare pipe or insulation in a snug and neat manner. They shall be of sufficient size to cover sleeved openings for the pipes and of sufficient depth to cover sleeves projecting above floors. Escutcheons shall be as manufactured by Beaton and Caldwell, Dearborn Brass or Grinnell.

E. Exterior wall sleeve through masonry walls shall be made water tight by the use of a Mechanical Seal Joint as manufactured by Century Products Link Seal.

F. Pipe sleeves shall be made of Schedule 40 pipe, 16 gauge galvanized steel or 16 gauge steel as follows:

1. Sleeves on pipes passing through masonry or concrete construction shall be Schedule 40 pipe.

2. Sleeves passing through masonry partitions shall be 16 gauge steel unless required otherwise by item 1. above.3. Sleeves on pipes passing through drywall construction shall be 16 gauge galvanized steel.

3. Sleeves on pipes passing through fire rated drywall partitions shall be 16 gauge steel.

4. Sleeves required on all pipes passing through all walls.

G. Pipe sleeves shall be set as follows:

1. Set sleeves 1 inch above finish floor (6 inches at penthouses and mechanical rooms) and flush on each side of walls, except sleeves through floor occurring in walls and partitions shall terminate flush with finish floor.

2. Sleeves shall be set securely in place before concrete is poured.

H. The Fire Protection Subcontractor shall firestop or smokestop the space between the sleeves provided under his Contract and pipes as applicable, as required by general conditions.

1.16 WATERPROOFING, FLASHING AND COUNTERFLASHING

A. Unless specifically indicated otherwise, the Fire Protection Subcontractor shall provide all counterflashing and waterproofing of all piping, and equipment provided by him, which pierce roofs, walls and other weather barrier surfaces. All work under this paragraph shall be coordinated with the Construction Manager.

B. All work shall be performed in a workmanlike manner to assure weatherproof installation. Any leaks developed due to this Subcontractor's work shall be repaired at his expense, to the Architect's satisfaction.

C. Pipes passing through slabs shall have the sleeve extended above floors as hereinbefore specified to retain any water and the space between the pipe and sleeve caulked with lead wool. The top shall be sealed with lead and the bottom shall be sealed with monolastic caulking compound. The space between the outside of the sleeve and the floor slab shall be caulked watertight sufficiently to hold 2 inches of standing water.

D. All flashing required for piping penetrations shall be provided by the Construction Manager.

1.17 MISCELLANEOUS IRON AND STEEL

A. The Fire Protection Subcontractor shall provide all steel supports and hangers as shown on the drawings and/or required to support all Fire Protection equipment, systems and materials provided under this Contract.

B. All work shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets and framework shall be properly sized and strongly constructed.

C. Measurements shall be taken on the job and worked out to suit adjoining and connecting work. Members shall be straight, true and accurately fitted.

D. Drilling, cutting and fitting shall be done as required to properly install the work and accommodate the work of other Trades as directed by them.

E. Members shall be generally welded except that bolting may be used for field assembly where welding would be impractical.

F. All shop and field fabricated iron and steel work shall be cleaned and dried and given a coat of rust inhibiting paint on all surfaces and in all openings and crevices.

1.18 ELECTRICAL WORK, MOTORS, MOTOR CONTROLLERS

A. All electrical apparatus and controls furnished as a part of the Fire Protection work shall conform to applicable requirements under Electrical Section.

B. The Fire Protection Subcontractor shall provide the Electrical Subcontractor with all electrical requirements within thirty (15) days from date of Contract to allow proper coordination of Trades by the General Contractor.

C. The Fire Protection Subcontractor shall verify with the Electrical Subcontractor available electrical characteristics before ordering any equipment or motors.

1.19 IDENTIFICATION OF MATERIALS

A. All equipment used in the Fire Protection systems shall have a permanently attached nameplate identifying the manufacturer, service, size, serial number or model number, etc. The nameplates shall be kept clean and readable at all times.

B. Each item of equipment not provided with a manufacturer's nameplate, shall be identified by a permanently attached nameplate made of black surface, white core laminated bakelite with 1 inch high indented letters. Nameplates shall be minimum of 5 inches long by 3 inches wide and bear the equipment name as designated in the equipment schedules or the specifications. Nameplates shall be as fabricated by Seton Nameplate Company, Atlantic Engraving Company, W.H. Brady Company or approved equal.

C. A legend showing the service and an arrow indicating the direction of flow shall be applied on each pipe installed by the Fire Protection Subcontractor.

D. The piping shall be identified in the following locations and where directed by the Architect.

1. Pipe mains and branches every 15 feet.
2. At each valve.
3. Each wall penetration (both sides).
4. Each riser including branch risers from mains.
5. At each piece of equipment.

E. The identification of piping shall be coordinated with the Owner. Obtain approval of Architect prior to installation. The letter size and background color shall conform to the ANSI Scheme for the Identification of Piping Systems (ANSI 13 latest amendment).

1.20 VALVE TAGS, NAMEPLATES AND CHARTS

A. All valves on pipes of every description installed by the Fire Protection Subcontractor, shall be provided with neat circular brass valve tags of at least 1 1/2 inches in diameter, attached with brass hook to each valve stem or handle. Tags shall have stamped on, in letters as large as practical, the number of the valve and the service, such as "FP", WSP, DSP, etc., for Fire Protection, wet sprinkler, dry sprinkler. The numbers of each service shall be consecutive. Obtain approval of Architect prior to installation.

B. All numbers utilized shall correspond to numbers indicated for valves on the Record Drawings and on two (2) printed detailed lists. These printed lists shall state the numbers and locations of each valve and the equipment or system which it controls and other necessary information such as requiring the opening or closing of another valve or valves when any one valve is to be opened and closed.

C. These printed lists shall be prepared in form to meet approval of the Architect and shall be framed under glass.

D. The Fire Protection Subcontractor shall provide for his work all valve charts including the Fire Protection Subcontractor's name and telephone number; date of chart; name and telephone number of Architectural Firm and Consulting Engineering Firm.

1.21 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

A. Refer to Section 01700 of Division 1 - General requirements for the requirements of this Section.

1.22 MANUFACTURER'S REPRESENTATIVE FOR START-UP OF SYSTEMS

A. The Fire Protection Subcontractor shall provide, at appropriate time or as directed by the Architect, the onsite services of a competent factory trained Engineer or authorized representative of particular manufacturer of equipment such as for the fire pump to instruct the Owner, inspect, adjust, test and place in proper operating condition any item provided by him, as applicable.

B. The Fire Protection Subcontractor, as applicable, shall commission and set in operating condition all major equipment and systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. In no case will major systems and equipment be commissioned by any of the Subcontractor's forces alone, without the assistance or presence of the equipment manufacturers.

C. A written report shall be issued by the particular equipment manufacturer and the Fire Protection Subcontractor summarizing the results of the start-up and performance of each system for the Architect's record. No additional compensation will be allowed for any Subcontractor for such services.

1.23 ELECTRICAL ROOM REQUIREMENTS

A. The Fire Protection Subcontractor shall not install any piping, or equipment in or through electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms, unless piping, or equipment is intended to serve these rooms. Additionally, no piping will be installed above electric panels or within the limits of any Code requirements. If the Fire Protection Subcontractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.

1.24 RECORD DRAWINGS

A. The Fire Protection Subcontractor shall maintain current at the site a set of his drawings on which he shall accurately show the actual installation of all work provided under his Contract indicating any variation from the Contract Drawings, in accordance with the General Conditions and Supplementary General Conditions. Changes whether resulting from formal change orders or other instructions issued by the architect shall be recorded. Include changes in sizes, location and dimensions of piping, equipment, etc.

B. Utilizing the coordination drawings described herein before, the Fire Protection Subcontractor shall modify/correct/edit the fire protection work on the above CAD coordination drawings, to obtain a “CAD” set of Record Drawings. Provide (2) blackline prints (2) copies of record drawing CAD files.

C. A marked-up and colored-up set of prints on-site will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner’s representatives and they shall be corrected if found either inaccurate or incomplete. This procedure is mandatory.

D. Coordination drawings are for the Contractor’s, Architect’s, and Owner’s use during construction and shall not be construed as replacing any shop drawings. The cad coordination drawings, when corrected for actual “as-built” conditions, will be reviewed by the Architect, corrected and will be used to formulate the Record Drawings to be submitted to the Owner for his use.

E. The Fire Protection Subcontractor shall submit a set of CAD files on disc marked “AS-BUILTS”. All costs associated with the production and reproduction of the CAD files shall be included under the fire protection bid for work under the fire protection contracts.

1.25 HOISTING EQUIPMENT AND MACHINERY

A. Refer to Section 01500 of Division 1 - General Requirements for the requirements of this Section.

1.26 STAGING

A. Refer to Section 01500 of Division 1 - General Requirements for the requirements of this Section.

1.27 SYSTEM DESIGN CRITERIA

A. Sprinkler systems and all components, piping, valves, head location, ratings, etc., shall be designed in accordance with NFPA 13, International Building Code and Owners Insurance Company and other applicable NFPA pamphlets governing the installation of alarm valves, system drains, etc. Fire Protection Subcontractor shall submit his shop drawings to City of Portland Fire Department and Owner's Insurance Company for approval prior to submission to Architect for approval.

B. The fire protection work is partially shown on the Fire Protection drawings. Each bidder for work under this Section of the specifications shall establish for himself, the exact quantity of heads required for the project and the exact extent of the work required. Refer to Architectural reflected ceiling plans for preferred sprinkler head locations. Additional heads shall be provided as part of this Contract, as required, to satisfy the Code requirements for the hazard stated.

C. Each Bidder shall refer fire protection drawings for major fire protection system's components, piping, as to which areas are to have fire department valves, hose cabinets, etc.

D. Provide sprinkler system in all areas that are a part of this Contract.

E. Hydraulic calculations shall be based on flow characteristics specified herein and on actual flow test performed/data obtained by the Fire Protection Subcontractor. The Fire Protection Subcontractor shall perform his own up-to-date flow test to hydraulically calculate this project. The Fire Protection Subcontractor shall submit to the Architect for his review; indication of test location, date, flow, residual and static pressure, etc., as outlined in NFPA #13. The Fire Protection Subcontractor shall coordinate the flow test with the Owner and Portland Water District and pay all costs and fees associated with flow test at no additional cost to the Owners.

F. Sprinkler system design shall be based on the following information and in accordance with the Owner's Insurance Company requirements:

1. Sprinkler systems shall be provided throughout the building and shall be hydraulically calculated to provide densities as specified on the drawings with hose allowance as required.

2. Flow Test Data

   a. Test Date: (For information only - see 3A below)
   b. Agency: Portland Water District
   c. Static Pressure:
   d. Residual Pressure:
   e. Flow Rate:
   f. Location: Steven's Avenue, Portland, ME

3A. Sprinkler contractor shall be required to perform their own hydrant flow-test prior to design. Coordinate with Portland Water District. Pay all required fees.

4. The hydraulic calculations shall include the hydraulically most remote areas for systems supplied by more than one combination riser. Hydraulic calculations shall show the remote areas being supplied solely from the hydraulically most remote combination riser.

G. The Fire Protection Subcontractor shall state in his bid the exact number of heads he deems necessary to adequately sprinkler the entire project, including the unit cost to add or deduct a single head from this stated quantity. Head cost shall include the provision of 10'0" linear feet of pipe and required elbows and offsets customarily associated with the installation of each type of head to be installed.

H. The Fire Protection Subcontractor will be required to prepare detailed shop drawings as hereinbefore specified. This information in the form of a single "Package" shall be submitted to the Architect for review and approval prior to fabrication and installation. "Package" shall bear approval of Local Building Department, Local Fire Department and Underwriter's Agent of Owner's Insurance Company prior to submission to Architect for his review. Include flow test information noted above.

1.28 SUBMITTALS

A. Shop drawing submittals shall be prepared and submitted as described herein and in accordance with Section 01300 - Division 1 - General Requirements and as modified and noted hereinafter.

B. Prior to final shop drawing submittals, prepare HEAD LOCATION ONLY DRAWINGS depicting all sprinkler head locations and submit them to Architect for approval. These drawings shall show locations of all heads and all required dimensions, etc., and shall show sprinklers, lights, HVAC diffusers, ceiling tile patterns and access panel locations. This must be provided. Refer to Section 1.2A of this specification for other submissions.

C. Disposition of shop drawings shall not relieve the Fire Protection Subcontractor from the responsibility for deviations from drawings or specifications, unless he has submitted in writing a

letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Architect, nor shall such disposition of shop drawings relieve the Fire Protection Subcontractor from responsibility for errors in shop drawings or schedules.

D. Submittal Procedures and Format:

1. Review submittal packages for compliance with Contract Documents and then submit to Architect for review.

2. Verify quantities and type of medium to be submitted as outlined in Section 01300.

3. Each Shop Drawing shall indicate in title block, and each Product Data package shall indicate on cover sheet, the following information:

4. Title.

5. Name and location of project.

6. Names of Architect, Engineer, Contractor and Subcontractor(s).

7. Names of manufacturer, supplier, vendor, etc.

8. Date of submittal.

9. Whether original submittal or resubmitted.

10. Verify scale and type of drawings required.

11. Shop Drawings showing layouts of systems shall contain sufficient plans, elevations, sections, details and schematics to describe work clearly. They shall be minimum 1/8" = 1'0" scale unless specified otherwise. Provide larger scale details as necessary. Drawings shall show elements of Architect's reflected ceiling plan, exposed ductwork, walls, partitions, diffusers, registers, grilles, access panels, sleeves and other aspects of construction.

12. All firewalls and smoke partitions must be highlighted on the drawings for appropriate coordination.

13. Shop drawings showing manufacturer's product data shall contain detailed dimensional drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data, alone, is not acceptable), electrical requirements and wiring diagrams. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and

other information necessary to demonstrate compliance with all requirements of Contract Documents.

E. Shop drawings shall include but shall not be limited to the following:

1. Sprinkler work layout drawings, including location and sizes of piping, pumps, heads, guards, flushing connections, drains, test stations, alarm valves, bells, gongs, and all other accessories as required by NFPA #13.

2. Hydraulic calculations per NFPA #13, and Owner's Insurance.

3. Equipment Cuts for:

a. Alarm bell.
b. Alarm valves.
c. Inspector's test valves.
d. Valves, gauges, drains and piping.
e. Guards, spare head cabinet.
f. Fire Department Connections with ball drip and check valves.
g. Hangers, supports.
h. Sprinkler heads, escutcheons.
i. Flow switches, tamper switches.
j. Access panels.

1.29 WORKING PLANS

A. Submit Working Plans and hydraulic calculations signed and sealed by Professional Engineer registered in state in which project is located to authorities that have jurisdiction, including:

1. Architect - as outlined in Section 01300
2. Insurance Underwriter
3. Fire Department
4. Authorities Having Jurisdiction

B. Submit Working Plans in one complete package. When it is not possible to submit entire system design in one package due to job conditions, submit plans of entire building indicating area not yet defined.

C. Working Plans shall be at least 1/8" = 1' scale on sheets of uniform size. Working Plans shall show all data required by NFPA Standards.

D. Working Plans will be subject to Architect's final approval. Submit to Architect after review by other authorities. If necessary to submit plans to Architect before review by other authorities,

identify authorities that have not reviewed plans and resubmit for final approval when review by all parties is complete.

E. Pipe sizing shall be based on hydraulic calculations in accordance with NFPA requirements.

F. Working Plans are fabrication drawings provided to indicate actual sprinkler system and/or combination system piping layout.

1.30 SITE VISIT

A. Before commencing any work under this section, verify all governing dimensions, elevations and locations at the building and examine all adjoining work on which this work is in any way dependent for its perfect efficiency according to the intent of these specifications. Visit and investigate all spaces and conditions to become familiar with installation and all requirements prior to bidding.

B. Each bidder shall visit the site and inspect all conditions affecting any aspect of the work. Failure to do so and misinterpretation of the plans and specifications resulting therefrom shall be entirely the responsibility of the bidder.

1.31 CORE DRILLING

A. This subcontractor shall perform all core drilling required for the proper installation of the fire protection system. Locate all required openings and prior to coring coordinate the opening with the General Contractor. Thoroughly investigate the conditions in the vicinity of the required opening prior to cutting. Care must be taken so as to not to disturb the hospital systems. Locate all other openings required for the General Contractor. All cored openings are to be by Fire Protection Contractor and all other openings are by the General Contractor. Patching of walls and openings shall be preformed by the respective trade responsible for the finish material in which the opening is made.

1.32 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Instruct to the Owner’s satisfaction such persons as the Owner designated, in the proper operation and maintenance of all Fire Protection systems and equipment and their parts.

B. Furnish operating and maintenance manuals prior to instructions and forward same to the Architect for transmittal to the Owner.

C. This Contractor shall give detailed instructions for a period of not less than 5 days, straight time, to the responsible personnel designated by the Owner in the operation and maintenance of all systems and equipment furnished under this Contract. A letter with five copies containing the name of the person or persons to whom the instructions were given and the dates of instruction period shall be submitted to the Architect/Engineer. Start-up and testing of all equipment supplied by this Contractor shall be performed by authorized factory representatives supplying equipment. Notification of this work must be given to the Owner.

D. This Contractor shall submit to the Architect/Engineer for approval four sets of operating and instruction manuals, spare parts lists, drawings, manufacturer's bulletins and other pertinent data on all equipment furnished under this Contract. Each set shall be enclosed in a suitable hard cover binder. This information must be submitted to the Owner when systems are approximately 90% complete to allow for proper review prior to final instruction.

E. Provide name, address, and telephone numbers of manufacturer's representative and service company for each piece of equipment so that service parts can be readily obtained.

F. Upon completion of instructions this Subcontractor shall provide step by step typed procedures to test and operate each piece of equipment including detailed cross referenced drawings to procedure outlined so that all equipment may be tested, shut down, turned on or bypassed by the Owner's representative.

PART 2 - MATERIALS

2.0 PIPE AND FITTINGS

A. Piping shall meet applicable ANSI or ASTM standards requirements and shall have manufacturer's name and standard marked on each length. Joints shall meet applicable ANSI and ASTM standards requirements. Where ANSI and ASTM standard does not exist, joints and fittings shall bear UL listing symbol.

B Sprinkler distribution and branch piping 2-1/2" in size and larger may be Schedule 10 black steel. Piping for sprinklers 2" and smaller in size shall be Schedule 40 black steel. .

C. Piping for use with hole-cut fittings shall have machine cut holes per manufacturer requirements at predetermined positions, on the centerline of the pipe, of a size to receive the housing locating collar.

D. Piping for use with grooved end fittings shall be roll grooved without metal removal.

E. Branch outlet fittings shall be UL listed and FM approved, rated for300 psi (MWP) on piping 2-1/2" and larger equal to Victaulic. 300 psi fittings to be used on system where working pressure is less than 175 psi.

1. Mechanical tee branch, hole-cut type connections, with locating collar engaging into hole, with standard pressure responsive gaskets and black nuts and bolts; or

2. Outlet couplings, construction as hereinafter specified for couplings, with outlets grooved or threaded outlet ends with standard pressure responsive gaskets and black bolts and nuts.

3. No strap, snap and or one bolt outlet fittings will be permitted.

F. Standard black cast iron screwed fittings shall be used on piping 2" and smaller and may be used on larger sizes.

G. All grooved couplings, fittings and mechanical tee branch fittings shall be Victaulic or approved equal.

H. Bushings shall not be permitted where fittings of required sizes are manufactured. Care shall be taken in the design of this work to avoid piping arrangements that would require bushings.

I. Unless specified otherwise herein, all fittings shall be in accordance with NFPA standards and subject to approval by the Architect/Engineer. All fittings are to be UL listed.

J. All close and shoulder nipples shall be of corresponding materials as the pipe and shall be extra heavy pattern.

K. All piping for fire mains, fire department pumper connections, and sprinkler risers shall be Schedule 40 piping with approved Victaulic joints, 300 pound class minimum fittings.

L. Regardless of size or type, fire protection contractor is responsible to supply pipe and fittings approved for the high pressures that will be developed.

2.1 HANGERS AND SUPPORTS

A. Hangers shall be NFPA approved adjustable swivel ring 2" smaller and clevis hanger 2 ½" and larger supported from structural steel or concrete floors above by approved type clamps and supports. Spacing and hanger rod size shall be as outlined in NFPA Pamphlets or as specified herein.

B. Piping at all equipment and control valves shall be supported to prevent strains or distortions in the connected equipment and control valves. Piping at equipment shall be supported to allow for removal of equipment, valves and accessories with a minimum of dismantling and without requiring additional support after these items are removed.

C. All piping installed under this section of the specification shall be independently supported from the building structure steel and concrete decks and not from the piping, wood decks, ductwork or conduit of other trades. All supplementary steel including factory fabricated channels, required to meet the requirements specified herein shall be furnished and installed by the Fire Protection contractor.

D. All vertical drops and runout pipes shall be supported by split-ring extension type hangers.

E. Pipe supports, vertical and horizontal, shall not bear on sleeves.

2.2 SPRINKLER HEADS

A. All sprinkler heads shall be listed by Underwriters' Laboratories, Inc., and approved by Owner's Insurance Underwriter. All heads shall be manufactured by a single manufacturer. All sprinkler heads to be quick response unless noted.

B. Sprinkler heads shall be provided and installed to conform with manufacturer's listing.

C. All heads within 8' - 0" of the floor in mechanical areas shall have sprinkler guards.

D. Heads shall be installed in the center of tiles.

E. Refer to sprinkler schedule on drawings.

F. In addition to the sprinkler heads actually required, furnish spare heads of each type and temperature rating used, as required by NFPA 13. Heads shall be placed in a baked enamel steel cabinet mounted as directed by the Owner. Cabinet shall contain two (2) socket wrenches and

shall be of adequate size to hold required head quantity, but not less than six (6) of each type. Provide multiple cabinets if necessary.

2.3 FIRE DEPARTMENT CONNECTIONS

A. Fire Department connections shall be Underwriters' Laboratories listed with interior self-closing clapper in each opening. Units shall be manufactured of rough brass, polished chrome plated complete with caps, plugs and chains. Threads on outlets shall conform to local Fire Department specifications. Potter Roemer #..

B. On branch line to pumper connection, provide approved straightway check valve installed in horizontal position. Piping shall be arranged to drain between check valve and siamese connection by approval ball drop connection piped to nearest drain or through wall..

C. Installation of the Fire Department connections shall be at location as shown on the drawings and/or approved by the Architect and all Authorities having jurisdiction.

2.4 VALVES

A. All valves shall be Victaulic MFG UL listed and FM approved, valves shall be rated at a minimum of 300 psi.

B. Shut-off and/or control valves shall be:

1. Outside screw and yoke valve. Cast iron body, bronze mounted, flanged ends, solid wedge, 300 psi, 2-1/2" in size and up. All bronze, 300 psi, solid wedge, threaded ends, 2" and under, all to be electrically supervised.

2. Bronze supervised slow close butterfly valve, threaded ends, stainless steel disc and stem, built-in supervisory switch, slow-close operator, up to 8" in size, 300 psi, or

3. Butterfly type indicating valves, ductile iron body, bronze disc, rubber seat, 300 psi, gear operator, with built-in supervisory switch, or
4. Pressure reducing valves shown on the drawings shall be UL listed and as manufactured by CLA-VAL Company model 90-21, or approved equal. Valve shall be rated for 300 psi with internal epoxy coating of the main valve.

C. Check valves shall be:

1. Iron body, bronze mounted swing check with flanged ends, 300 psi, 2-1/2" in size up to 8" size; or

2. Iron body, spring actuated, wafer check, 300 psi, sizes 4" through 8" UL; or

3. Grooved end, iron body, spring activated, 300 psi, sizes 2-1/2" through 6"; or

4. All check valves up to 2" in size shall be all bronze with screwed ends.

D. Trim Valves: (for use on inspectors test set ups, alarm check valves, dry pipe valves, etc.)

1. Gate valves - all bronze, 300 psi, solid wedge, outside screw and yoke, rising stem, screwed ends.

2. Ball valves - all bronze, 300 lb. WWP, screwed ends.

3. Globe valves - all bronze, 300 lb. WWP, screwed ends.

4. Check valves - all bronze swing check, rubber disc, 300 lb. WWP, screwed ends.

E. All valves that are installed as a part of this specification shall be provided with pressure ratings suitable for their intended service.

F. Test stations shall be Gem Mfg. or Victaulic Mfg. equal to Gem #F350 (TESTMASTER Assembly) sectional test and drain with 2" minimum pressure relief valve if required.

2.5 SPRINKLER ALARM BELL

A. Reliable System Sensor alarm bell, red color with appropriate labeling.

2.6 SIGNALING DEVICES

A. Valve monitor switches, sprinkler flow switches, water pressure alarm and low air pressure switches shall be furnished and installed by this Contractor, but wired by the Electrical Contractor.

1. Electrical supervisory switch locks or "tamper switches" shall be Viking, Gem, or Grinnell with two sets of double throw, single pole contacts. **No cords on switches allowed.**

2. Water flow alarm devices shall be Viking, Grinnell, or Gem, valve type, with two sets of double throw, single pole contacts and with 60 second time delay mechanism.

3. Reliable or approved equal 6" electric alarm bell for weatherproof operation.

B. The Fire Protection Subcontractor shall prepare a typewritten list of all equipment to which the Electrical Subcontractor shall make connections. This list shall include all electrical

characteristics of each piece of equipment. This is to be done to insure items that the Fire Protection Subcontractor is to provide are compatible with the building electrical requirements. Submit this list prior to purchasing any equipment.

2.7 ACCESS DOORS

A. Furnish for installation by designated Trade as determined by the General Subcontractor access doors in all locations where valves, switches or other similar equipment are installed above plaster ceilings or behind walls or anywhere they become not accessible for inspection, maintenance or servicing. Access doors shall be a minimum of 18 inch by 12 inch or shall be sized to suit the access requirement to service the equipment and shall be located individually and in a manner approved by the Architect and to meet requirements specified here and elsewhere for specific applications.

B. Doors shall be set square and flush in cooperation with the Subcontractors. Particular attention shall be exercised in the selection of doors for masonry walls in order that frame sizes used, will match the courses of brick or block. Where possible, access panels shall be located in closets, storage rooms and/or other nonpublic areas and shall be constructed in a workmanlike manner. Doors shall be positioned so that the junction can be easily reached. Where access panels are required in corridors, lobbies or other habitable areas, they will be located as directed by the Architect.

C. Doors shall be constructed of steel with primer coat of rust inhibitive paint and shall have continuous piano hinge, as manufactured by Inland Steel Products Milcor, Miami, Walsh-Hannon or approved equal. Doors shall be key operated with flush operated cylinders, keyed alike. Key lock system shall be coordinated with the Hospital and shall be as approved by the Architect. Provide six (6) keys of type used for access panels for Owner's use. Obtain receipt of key delivery and submit to Architect for record.

1. Masonry non-rated walls Style "M" with 16 gauge frame and 14 gauge panel.

2. Masonry fire rated walls Fire Rated with FM and UL, 2 hour "B" rating, 16 gauge frame, 20 gauge sandwich type insulated panel.

3. Suspended lath and plaster ceilings Style "K" with 16 gauge frame, 14 gauge panel.

4. For access panels larger than 16 inches in either direction, provide two (2) locksets.

2.8 MAIN ALARM CHECK

A. Reliable Model E-6" alarm check valve with associated trim as shown on drawing. Valve to be rated for 300 psi working system pressure.

1. Wet alarm valve shall be UL listed and FMG approved for a wet pipe sprinkler system, complete with ductile iron body, flanged or grooved outlet, main drain valve, pressure gauges, alarm port, external bypass, hand hole with cover, hinged clapper assembly and

other required trimmings. Valve shall be equal to Reliable Model E, Victaulic, Grinnel or Viking for variable pressure vertical installation with water motor and chrome plated gong. Water motor and gong shall be located on the outside of building. Supply pipe to gong and drain shall be IPS brass, galvanized steel or copper.

2. Excess pressure kit to be Gamewell #26615-7 with associated control wiring, pressure switches, supervisory panel, mounting brackets, pump and motor. Motor shall operate from differential pressure switch. Furnish with alarm lights and alarm dry contacts. Pump capacity: 1 GPM, 175 psi max, 1/4 HP, 120V.

3. Valve trim shall include pressure activated electric alarm switch.

2.9 SEISMIC BRACING

A. The Fire Protection Subcontractor shall provide all necessary design and materials for seismic restraint and protection of piping and devices against damage where subject to earthquakes as required for the entire plumbing system within the building. All isolation and seismic devices shall be the product of a single manufacturer. Products of other manufacturers are acceptable provided their systems strictly comply with this section of the specifications. Provide isolation materials and seismic restraints complete and as manufactured by Mason Industries, Tolco or approved equal.

B. The work under this section shall include the design, furnishing and installation of all restraint devices and systems as may be required for the fire protection system including, but not necessarily limited to, the following:

1. All fire protection equipment and devices.
2. All fire protection system piping as required.
3. Piping penetrations through floors and walls.
4. Sleeves with clearances around the outside, as recommended.
5. Equipment isolation bases.
6. Piping flexible connectors.
7. Seismic restraints for isolated equipment.
8. Seismic restraints for non-isolated equipment.
9. Certification of seismic restraint designs.

C. Submit ten (10) copies of descriptive data for all products and materials, including the following:

1. Catalog cuts and data sheets for the specific isolators, restraints and all other items to be utilized.
2. Details of methods of sleeving, fire protection smokeproofing and isolation for pipes penetrating walls and slabs.
3. Specific details of seismic restraints and anchors, including number, size and locations for each piece of equipment.

4. Calculations to support seismic restraint designs.
5. All calculations, details and other submittal materials shall be sealed and signed by a structural or civil engineer registered in the state and qualified to perform seismic design calculations.
6. A seismic design liability insurance certificate that must accompany all submittals.

D. Code and standards requirements shall include, but not be limited to:

1. Applicable IBC with any additional State or Local requirements.
2. NFPA 13 and 24 and other applicable NFPA standards.
3. All State and Local codes.

E. Manufacturers working in this section must provide a seismic design liability insurance certificate and certify their ability to provide engineering and design as required by this section. This certificate shall be submitted to the architect for review prior to any submittals.

1. Manufacturer's Listed and Approved Design Manual

2.10 BUILDING AUTOMATION SYSTEM

The building automation system (BAS) shall be furnished and installed under another Section. The Fire Protection Contractor shall provide dual contact pressure switches, tamper switches, flow switches, tees, pipe wells, valve caps and/or additional contacts at equipment control/alarm panels to allow the connection from the BAS system to the piping and/or equipment where required. The following table itemizes the equipment, location and type of alarm or contact point and condition necessary to connect to the BAS system.

PIPE OR EQUIPMENT	TYPE OF ALARM, CONTACT POINT OR CONDITION WHICH SHALL BE MONITORED BY BAS	CONTROL	LOCATION
Main Alarm Check Valve	Open	Pressure Switch	Sprinkler Room – Basement Floor Level
Fire Protection Supply	Low Pressure	Pressure Switch	Sprinkler Room – Basement Floor Level

2.11 ELECTRICAL CONTROL AND INTERLOCKING WIRING

A. The electrical contractor shall furnish and install power wiring 480/208 volt, 120 volt connection only to all Fire Protection connected equipment including panels and motors. This Fire Protection subcontractor shall mount panels and shall furnish and install all control and interlocking wiring for each piece of Fire Protection equipment including but not limited to remote alarms and local alarms for all Fire Protection and equipment, alarms, pressure switches, flow switches and solenoid valves. All control wiring and interlocking wiring shall be installed in conduit and in accordance with the respective manufacturer's requirements and all connections shall be provided by the fire protection subcontractor. Wiring and conduit provided by this subcontractor shall be installed in accordance with the requirements of SECTION 16000 of the specifications.

B. All electrical panels and life support panels shall be equipped with connection for emergency power hook-up.

2.12 DOUBLE CHECK VALVE ASSEMBLY

A. Double check valve assembly on fire protection water service shall be Watts Model 709 double check assembly or FEBCO with FDA approved epoxy coated cast iron check valve bodies with bronze seats, bronze bodied ball valve test cocks, U.L., FM approved outside stem and yoke gate valve shut-offs, repair kit, test kit and pressure gauges. Valve assembly shall be mounted in accordance with City and State Requirements and properly secured to the wall or floor stand mounted. Assembly shall be tested and certified under AWWA std. No. C506 and FCCCHR of USC manual, Section 10 and listed by U.L.

2.13 DUCTILE IRON PIPE AND FITTINGS – FIRE SERVICES

A. Thickness Class 52 cement lined ductile iron pipe conforming to AWWA C151-7, flanged ends.

B. Fittings shall be ductile iron, cement lined, 250 psi rating, flanged ends.

C. Shall be used for Fire Protection water services outside of building. Shall be used for Fire Protection service within building up to 6” DSCV assembly.

PART 3 - INSTALLATION

3.1 GENERAL

A. The contract drawings intend to show only the scope of the design, the fire protection subcontractor shall be responsible for the correct installation of this work in a manner satisfactory to the best practices of his trade to complete the scope of this subcontract in all respects. All roughing to equipment shall be accomplished in all details to Specifications of equipment manufacturer and to approval of Architect. No roughing work shall be accomplished until the pertinent manufacturer's shop drawings are approved.

B. The location of piping as indicated on the Drawings, unless otherwise noted, is diagrammatic only, and the exact locations shall be determined in the field. The run and arrangement of all pipes shall be approximately as shown on the Drawings, as directed during installation, in strict accordance with NFPA Pamphlets, and as straight and direct as possible, forming right angles or parallel lines with building walls and other pipes, and neatly spaced. All risers and standpipes shall be erected true and plumb, parallel with walls and other pipes, and neatly spaced. All horizontal runs of piping, except where concealed in partitions, shall be kept as high as possible and close to walls. All piping shall be concealed and concealed piping shall have a minimum number of fittings. Piping shall not interfere with the operation or accessibility of doors, windows, access panels, valves, H&V unit access, air flow patterns, or equipment, and shall not encroach on aisles or passageways. All piping shall be installed to preserve access to all valves, drains and equipment. Pipe will not be permitted to pass through footing, beams or ribs. Make such offsets and deviations from the Drawings as may become necessary to meet actual field conditions.

C. The Fire Protection Subcontractor shall be responsible for the correctness of field dimensions and shall check for himself all grades, lines, measurements, and other data in any way effecting his work. He shall refer to the project phasing schedule together with architectural and structural drawings of other trades for a full comprehension of the extent of the work to be performed and to avoid interference, and shall not be entitled to any extra compensation for any additional work or expense arising from his failure to do so. In case interference develops the Architect shall decide which work is to be relocated, regardless of which was first installed. Work installed by the fire protection subcontractor which is improperly located and/or interferes with or modifies either the phasing schedule or the architectural or structural design, shall be changed as directed by the Architect, and all costs incidental to such changes shall be paid by the fire protection subcontractor.

D. The fire protection subcontractor shall coordinate all his work with the work of all other trades, and shall so arrange his work that there will be no delay in the proper installation and completion of any part or parts of each respective work wherein it may be interrelated with his, so that generally all construction work can proceed in its natural sequence without unnecessary delay, close coordination is also required with the HVAC, plumbing and electrical subcontractors in areas serving these trades.

E. Contact between piping and dissimilar metals such as hangers, building structural work, or equipment shall be avoided to prevent galvanic action.

F. Pipe shall be cut accurately to measurements established at the site and shall be worked into place without springing or forcing. All pipe, regardless of how cut throughout the job, shall be reamed smooth and all burrs removed before being installed. Pipe shall not be split, bent, flattened, nor otherwise injured either before or during the installation. Full lengths of pipes shall be used wherever possible and short lengths of pipe connected with couplings will not be permitted.

G. The Fire Protection Subcontractor shall use every precaution in the installation of all piping to prevent dirt, chips, or other foreign materials entering the inside of piping. All pipes shall be clean and blown out to the satisfaction of the Architect before closing of any line. Keep the ends of piping capped or blind flanged during the construction of the system to keep out dirt or other foreign matter. The plugs and caps are to remain until permanent and final installation is made. The use of paper, waste, rags and so forth to close openings will not be permitted.

H. Unions or flanges shall be installed at all equipment valves and at such other places as may be necessary to disconnect piping or at each piece of equipment or accessory which may have to be disconnected to make repairs.

I. Bushing will not be inserted in fittings for reduction in size where fittings of required size are manufactured.

J. The Fire Protection Subcontractor shall also provide the necessary data and supervision for the provision of all holes in the structure, and also for the installation of equipment foundations, including bolt hole templates, weights and manufacturer's recommendations for proper emplacement design. This shall be furnished to the General Contractor and other related subtrades.

K. Equipment and accessories shall be set level, plumb and in proper alignment with reference to adjacent walls. All surfaces coming in contact with walls, floors or other equipment shall have properly planed surfaces with suitable contact on wall and floors.

L. Sprinkler heads shall be located in centers of tile.

M. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible, before start of spray fiber work. Piping and equipment that interfere with proper application of fireproofing shall be installed after completion of spray fiber work. Patch and repair spray fireproofing cut or damaged during course of work specified under this Section. Trade responsible for damage shall bear cost of repair.

3.2 INSTALLATION REQUIREMENTS

A. Subcontractor shall comply with all the rules, Codes, Ordinances, regulations and requirements, of all legally constituted Authorities Having Jurisdiction over the whole or any part of the work herein specified. These requirements are minimum criteria and no reductions permitted by Code will be allowed without written permission of the Architect.

B. All equipment and materials furnished in connection with the installation shall be new and furnished in accordance with the requirements of this specification and they shall be of the best grade and quality of their respective kinds, free from natural, manufacturing or construction flaws, defects or irregularities and finish, fittings and workmanship shall be equal to the highest commercial grade.

C. Castings of all metals, of all kinds, shall be clean, smooth, close grained, of uniform thickness and free from all defects such as sandholes, blisters or cracks.

D. Before the installation will be accepted, Subcontractor shall have every portion of his work in a first-class working condition.

E. Where planning the installation of any of the apparatus herein called for, sufficient clearance shall be allowed to permit the removal and replacing of parts that may require future removal for repairs and replacement.

3.3 TEMPORARY STANDPIPE SYSTEMS

A. All standpipe risers shall continue up through the floors and temporary hose, nozzles and valves provided as required as the floors are erected for fire protection during construction. Standpipes shall be supplied through a temporary siamese inlet at grade located where directed by the Fire Department. Access to temporary siamese inlet connection shall be kept clear and accessible at all times. It shall be the responsibility of this Subcontractor to insure this temporary fire protection supply be available at all times. All valves shall be properly adjusted for the maximum pressure setting allowable as required and a typewritten report of such tests and adjustments shall be submitted to the Architect/Engineer.

3.4 IDENTIFICATION

A. All labeling of piping, materials and equipment, as outlined hereinafter for identification purposes, shall be performed by this Contractor.

B. Piping systems shall be identified with approved snap-on covers designating services and direction of flow. Location of identification covers shall be near access panels wherever possible and on both sides of valves. The markers shall be as manufactured by WH Brady Co., Westline Products, Seton Name Plate Co., or approved equal.

C. Before the snap-on labels are applied, piping shall be thoroughly cleaned and painted, if specified.

D. Letters shall not be less than 1-1/2" in height. Arrows shall not be less than 9" long. Identification shall be installed on pipes above hung ceiling and furred spaces.

E. All systems shall be identified at intervals of approximately 20' change of direction and on both sides of wall where pipes pass through walls.

3.5 TESTING AND INSPECTION

A. This Contractor shall obtain and pay for all the inspection and tests required for this Section of the work. Defects discovered in work, materials and/or equipment shall be replaced at no cost to the Owner, and the inspection and test shall be repeated. When work is completed, this Contractor shall furnish a Certificate of Inspection and Approval to the Owner before final payment of the Contract will be allowed.

B. Test sprinkler piping and make watertight before concealment. Make partial tests as required, during the progress of the work. All tests shall be witnessed by the Owner's representative, Authorities Having Jurisdiction and a representative of the Engineer.

C. Sprinkler system shall be tested to a hydrostatic test of 400 psi for two (2) hours in accordance with NFPA as a minimum testing requirement.

D. This Subcontractor shall, with the parties noted herein, establish procedures to witness testing that are acceptable to the parties noted herein. All parties noted herein shall be notified in writing of the accepted testing procedure prior to any testing. This Subcontractor shall notify parties designated to witness testing at least 48 hours in advance of scheduled testing.

E. Conditions requiring testing in excess of the minimum requirements noted herein shall be performed in accordance with NFPA standards and any requirements of Authorities Having Jurisdiction.

F. Should the Owner, Architect, Engineer or any Authority Having Jurisdiction require, this Subcontractor shall provide factory trained, manufacturer's authorized representatives to perform testing on any equipment and/or devices that may be an integral part of this specification.

G. Dispose of test water and wastes after tests are complete, in a manner satisfactory to the Architect.

H. Furnish to the Architect/Engineer completely executed test certificates with signatures of those required to witness testing. Test certificate forms shall follow NFPA formats as a minimum requirement.

I. All electrical alarm devices are to be tested and adjusted in conjunction with the Electrical and/or Fire Alarm Subcontractors. Testing or retesting and adjustment of these devices shall be at no additional cost to the Owner. Testing and adjustment shall be as required until these devices are performing as an integral part of the total alarm system as specified for that part of the work.

3.6 CLEANING OF SYSTEMS

A. Before the Fire Protection Systems are accepted, all equipment shall be thoroughly cleaned to remove all dust, dirt, and/or other foreign matter which may be detrimental to the operation of the Systems or building finishes.

B. After the installation is complete, equipment with factory finished surfaces shall be cleaned. Damaged or scratched spots shall be touched up with the same type and color paint as applied at the Factory.

C. All equipment that is to receive finish paint by the Painting Contractor shall be cleaned by this Contractor and left ready to have surfaces prepared to receive paint.

3.7 EQUIPMENT ACCESS REQUIREMENTS

A. All work shall be installed so that all parts requiring inspection, operation, maintenance and repair are readily accessible. Minor deviations from the Drawing may be made to accomplish this, but changes of magnitude shall not be made prior to written approval from the Architect.

B. Furnish access panels if required in walls and ceilings as required to permit access for adjustment, removal and the replacement and servicing of all equipment, and all other items requiring maintenance and adjustments. Access panels shall be installed by the General Contractor or respective Subcontractor.

3.8 SIGNS

A. Signs and nameplates in accordance with NFPA standards and/or this specification shall be provided at all drains, test and alarm valves and other areas as required by NFPA Standards.

3.9 MATERIALS AND EQUIPMENT HANDLING

A. Refer to Section 01600 of Division 1 - General Requirements for the requirements of this Section.

3.10 CLEANUP

A. After completion of the work, all tools and other equipment shall be removed from the building. All excess materials shall be removed and the building left broom clean. All cabinets, valves, and equipment shall be cleaned and polished.

B. This Contractor shall clean, patch and repair any material and finish of the building or its contents damaged during the execution of this Contract.

3.11 PROJECT CLOSE-OUT

A. In order to closeout the project the contractor must submit to the Owner (3) binders that include copies of the following:

1. Inspectional services sprinkler permit to install Fire Protective Systems.

2. Portland Fire Department permit to install a fire extinguishing system: 14:02.

3. Contractor's material and test certificate for above ground piping for Automatic Sprinkler Systems (NFPA 13).

4. Tamper and Flow Alarms; Certificate of Completion NFPA 72. To be provided by electrical Subcontractor or alarm service company.

5. A copy of an affidavit from the Architect or Engineer, of record, whose competency is consistent with the registration laws and regulations of The State of Maine. The affidavit shall indicate that he or she has made on-site visits and that the work has been completed satisfactorily as required.

END OF SECTION

SECTION 15300 - FIRE PROTECTION

INDEX

SECTION 15400 - PLUMBING

PART 1 – GENERAL

1.1 REFERENCES

A. All of the Contract Documents, including General and any Supplementary Conditions and Division 1- General Requirements, apply to the work of this Section.

B. Examine all Drawings and all other Sections of the specifications for requirements herein affecting the work of this trade.

C. This specification requires a preparation and submissions of drawings and other documents, procurement of approvals and provision of a complete functional plumbing systems. As a result, this Section serves dual purposes of providing specifications and indicating design criteria for the Plumbing Subcontractors use and guidance in preparing plumbing installation drawings and other documents for approvals.

D. The bid for work under Section 15480 shall be included with this bid.

1.2 DEFINITIONS

A. Words in the singular shall also mean and include the plural, wherever the context so indicates and words in the plural shall mean the singular, wherever the context so indicates.

B. Wherever the terms “shown on drawings” are used in the specifications. they shall mean “noted”. “indicated”, “scheduled”, “detailed”, or any other diagrammatic or written reference made on the drawings.

C. Wherever the term “provide” is used in the specifications it will mean “furnish” and “install”, “connect”, “apply”, “erect”, “construct”, or similar terms, unless otherwise indicated in the specifications.

D. Wherever the term “material” is used in the specifications it will mean any “product”, “equipment”, “device”, “assembly”, or “item” required under the Contract, as indicated by trade or brand name, manufacturer’s name, standard specification reference or other description.

E. The terms approved”, or “approval” shall mean the written approval of the Architect.

F. The term “specification” shall mean all information contained in the bound or unbound volume, including all “Contract Documents” defined therein, including all drawings.

G. The terms “directed”, “required”, “permitted”, “ordered”, “designated”, “prescribed” and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect. The terms “approved”, “acceptable”, “satisfactory” and similar words shall mean approved by, acceptable or satisfactory to the Architect. The terms “necessary”, “responsible”, “proper”, “correct” and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.

H. “Piping” includes in addition to pipe or mains, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

I. “Concealed” means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.

J. “Exposed” means not installed underground or “concealed” as defined above.

K. “Plumbing Sub-Contractor”, refers to the Sub-Contractor or his Sub-Contractors responsible for furnishing and installation of all work indicated in the Plumbing specifications and as shown on the plumbing drawings.

1.3 SCOPE OF WORK

A. Work Included: The scope of work, without limiting the generality thereof, consists of furnishing all labor, materials, plant, transportation, equipment, accessories, appurtenances, and services necessary and/or incidental to the proper completion of all plumbing work shown on the drawings, described in the specifications, or as reasonably inferred from either, in the opinion of the Architect, as being required, and includes, but is not limited to:

All work in Section 15480 Medical Gas & Dental Systems and Vacuum
Domestic water service to 10’-0 from building.
Soil, waste, kitchen waste and vent systems to 10'-0" from building
Roof drain and conductor pipe system to 10'-0" from building
Domestic cold and hot water systems
Non-domestic cold water systems
Natural gas piping system
Insulation
Plumbing fixtures
Floor, roof and area drains
Instructions to Owner
Backflow preventers
Water meter
Core drilling
Furnishing of access panels
Building automation system connections
Testing, disinfection and certification
Connections to plumbing connected equipment and sterilizer equipment furnished under other sections (washers, sterilizers, casework equipment, etc.)

Valves and accessories
Cleanouts
Domestic water heaters and circulators
Chair carriers and supports
Installation of toilet accessories
Trap primers
Shock absorbers/air chambers
Wall hydrants
Record coordination drawings - CADD Submission
Thermostatic master mixing valves
Heat tracing
Point of use mixing valves
Hangers, sleeves and appurtenances
Pressure reducing valves
Core drilling
Indirect wastes
Interlocking and control wiring
Cleaning and adjusting
Staging, scaffolding and rigging
Seismic restraints
Installation of fireproofing sleeves
Miscellaneous iron and steel

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. Electrical Work - Section 16100.

B. Finish Painting - Section 09900.

C. Temporary power for operation of pipe cutting, welding and threading tools - Section 01500

D. Fire Protection Work - Section 15300.

E. Heating Work - Section 15600

F. Concrete housekeeping pads - Section 03300.

G. Installation of access panels - Trades in which they occur.

H. Excavation, backfill and resurfacing - Earth Work - Section 02200.
I. Drainage structures and appurtenances - Section 02700. Beyond 10 feet.

J. Toilet accessories - Section 10800.

K. Site utilities beyond 10 feet from building

L. Furnishing of fire stop material

M. Pneumatic Tube - Section 14700.

1.5 CODES, STANDARDS AND REFERENCES

A. All materials and workmanship shall comply with all applicable State Codes, Specifications, Local and State Ordinances, Industry Standards, Utility Company Regulations and latest editions.

B. In case of difference between State Building Codes, State Laws, Local Ordinances, Industry Standards, Utility Company Regulations and the Contract Documents, the Plumbing Subcontractor shall promptly notify the Architect in writing of any such difference.

C. In case of conflict between the Contract Documents and the requirements of any Code, Authorities having jurisdiction, the most stringent requirements of the aforementioned shall be included in the bid and assume that will be provided unless otherwise directed by the Architect after award of Contract.

D. Should the Plumbing Subcontractor perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations, he shall bear all costs arising in correcting the deficiencies, as approved by the Architect.

E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations, and the applicable requirements of the following accepted Codes and Standards, without limiting the number, as follows.

1. Local and state building, plumbing, mechanical, electrical, fire and health department codes.
2. National Fire Protection Association (NFPA)
3. Occupational Safety and Health Act (OSHA)
4. Building Owner’s Insurance Company
5. Underwriters' Laboratories (UL)
6. International Building Code

F. In these specifications, references made to the following Industry Standards and Code Bodies are intended to indicate the accepted volume or publication of the Standard. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:

1. ANSI American National Standards Institute
2. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
3. ASME American Society of Mechanical Engineers
4. ASTM American Society of Testing Materials

5.	AWS	American Welding Society
6.	CS	Commercial Standards, U.S. Department of Commerce
7.	FM	Factory Mutual
8.	NFPA	National Fire Protection Association
9.	CGA	Compressed Gas Association
10.	FS	Federal Specification, U.S. Government
11.	HI	Hydraulics Institute
12.	MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
13.	NEMA	National Electrical Manufacturers Association
14.	OSHA	Occupational Safety and Health Act
15.	UL	Underwriters' Laboratories, Inc.

G. The Plumbing Subcontractor for the work shall give all necessary notices, obtain all permits, pay all governmental taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. The Plumbing Subcontractor shall obtain and pay for all required Certificates of Inspection for his work and deliver same to the Architect before request for acceptance of his portion of work is made and before final payment.

1.6 GUARANTEE

A. Attention is directed to provisions of the General Conditions and Supplementary General Conditions regarding guarantees and warranties for work under this Contract.

B. Manufacturers shall provide guarantees for work under this Contract. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and the Contractor may have by Law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the systems, as determined by the Architect and shall remain in effect for a period of (12) months thereafter.

C. All materials, items of equipment and workmanship furnished under each Section shall carry the standard warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the Plumbing Subcontractor including all other damage done to areas, materials and other systems resulting from this failure.

D. The Plumbing Subcontractor shall guarantee that all elements of the systems provided under his Contract, are of capacity to meet the specified performance requirements as set forth herein or as indicated on the drawings.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the Plumbing Subcontractor, within (5) working days, at no cost to the Owner.

F. The Plumbing Subcontractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

G. Upon final acceptance of the project by the Owner, the (1) year guarantee period of all equipment and materials will be initiated. During this period, the Contractor shall make a minimum of (2) visits to the site (6) months after acceptance and immediately prior to the end of the guarantee period). These visits shall be performed in the presence of the Owner's representative. During each visit, the Contractor shall thoroughly check all equipment for proper operation and respond to any list of deficiencies prepared by the Owner. Formal reports shall be generated and forwarded to the Department of Engineering and Architect's Office describing the systems inspected, date of inspection and status of equipment.

1.7 THE SUBCONTRACTOR

A. The Plumbing Subcontractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications and shall take all responsibility for and bear all losses resulting to him in the execution of his work.

B. The Plumbing Subcontractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed directly or indirectly by the Plumbing Subcontractor shall perform their work according to all the conditions as set forth in these specifications.

C. The Plumbing Subcontractor shall furnish all materials and do all work in accordance with these specifications and any supplementary documents provided by the Architect. The work shall include every item shown on the drawings and/or required by the specifications as interpreted by the Architect. All work and materials furnished and installed shall be new and of the best quality and workmanship. The Plumbing Subcontractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed

1.8 COORDINATION OF WORK

A. The Plumbing Subcontractor shall compare his drawings and specifications with those of other Trades as well as the Architectural drawings and specifications, and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the plumbing work. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, Plumbing Subcontractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the plumbing work caused by the Plumbing Subcontractor's neglect, shall be made by him at his

own expense, to the Architect's satisfaction. The Plumbing Subcontractor must include in his bid sufficient dollar amounts to coordinate the work of this Contract.

B. Locations of pipes and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. The Plumbing Subcontractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component.

C. Lines which pitch shall have the right-of-way over those which do not pitch, For example: waste piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.

D. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The Plumbing Subcontractor shall provide cleanouts and drains as required for his work to effect these offsets, transitions and changes in direction.

E. All work shall be installed in a way to permit removal (without damage to other parts) of coils, filters, control appurtenances, shafts, sheaves and drives and all other system components provided under this Contract requiring periodic replacement or maintenance. All piping shall be arranged in a manner to clear the openings of swinging overhead access doors as well as ceiling tiles. All work shall be done to allow easy access for maintaining equipment. The Owner and Engineer will require proof via the preparation of large scale sections and part plans that valves, cleanouts, etc. are accessible after the work is completed. Any items in the field discovered to be in non-compliance shall be removed and relocated, as required, and as directed by the Architect.

F. The Contract Drawings are diagrammatic only intending to show general runs and locations of piping, equipment, terminals and specialties and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom.

G. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, flow switches, etc., exist, such conflicts shall be reported to the Architect during bidding and prior to signing of the Contract. If such action is not taken, the Plumbing Subcontractor shall furnish such items as part of his work as necessary, for complete and operable systems and equipment, as determined by the Architect.

H. The Plumbing Subcontractor shall coordinate the installation of all equipment and any catwalks or service platforms provided.

I. Where drawing details, plans, specification requirements and/or scheduled equipment capacities are in conflict and where pipe sizes of same pipe are shown to be different between plans and/or between plans and sections or details, the most stringent requirement will be included in the Contract. Plumbing systems and equipment called for in the specification and/or shown on the

drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.

J. Final location of all exposed control valves, access panels, fixtures, control devices, wall hydrants, hose bibbs etc., shall be coordinated with the Architectural reflected ceiling plans and/or other Architectural details, as applicable. Obtain approval of locations of all devices from Architect in the field. Equipment shown on the plumbing and/or Architectural drawings to be provided with services, shall be included under this Contract as applicable, including all piping connections to systems, to make equipment complete and operable. Additional piping, flexible fittings, etc., shall be provided to accomplish the above requirement, as required, all as part of this Contract, at no extra cost to the Owner. This requirement necessitates that the Plumbing Subcontractor review the architectural drawings and the drawings of other Trades during bidding to ascertain the extent of all requirements, and interface between the Trades and scope of work.

K. The Plumbing Subcontractor shall coordinate his work with other Trades' work so that all equipment and systems can be easily, safely and properly serviced and maintained. It is imperative that service personnel can safely access all equipment. Provide safety rails, steps, ladders, valve chains, handle extensions, etc. as required, in addition to the ones shown on the drawings, to ensure safe and easy access to all equipment and is provided in a manner approved by the Architect and the Owner's Project Manager

1.9 GIVING INFORMATION

A. The Plumbing Subcontractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the Architect and other Contractors sufficiently in advance of the work so that all openings may be built in advance.

1.10 EQUIPMENT AND MATERIALS

A. Equipment and materials shall be delivered to the site and stored in location as directed by the Architect, in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls, filters, etc., shall be stored in dry, heated spaces.

B. The Plumbing Subcontractor shall have his equipment tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned, polished thoroughly and turned over the Owner in a condition satisfactory to the Owner and Architect. Damage or defects developing before acceptance of the work shall be made good at the Plumbing Subcontractor's expense.

C. The Plumbing Subcontractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.

D. The manufacturers listed within this specification establish the standards of quality required, either by description or by references to brand name, name of manufacturers or manufacturer's model number. Where one product only is specifically identified by name or manufacturer's model number, the Plumbing Subcontractor shall base his bid on the use of the name product. Where multiple names are used, the Plumbing Subcontractor shall base his bid on the use of any of those products named. The Plumbing Subcontractor shall submit with his bid, the names of products which are proposed as substitutions for products named in the specifications. Each proposed substitution shall be accompanied by a written statement of money to be added or deducted from his bid. The Owner reserves the sole right to accept or reject said substitutions with or without cause. When equipment and/or materials are proposed to be purchased from a manufacturer other than those specified, the Plumbing Subcontractor shall provide with his bid, data sufficient to inform the Owner and Engineer of the basis of equality of the substitution to that of the equipment and/or materials specified. When equipment other than that specified is used, the Plumbing Subcontractor shall be solely responsible for any extra cost of required revisions such as structural steel, concrete, electrical, piping, and any engineering review, coordination with other Trades, or redesign, etc. Such additional cost shall be identified at the time such substitutions are proposed and incurred by the Plumbing Subcontractor.

E. Manufacturers' directions shall be followed completely in the delivery, storage, protection and installation of any equipment. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's written instructions before proceeding with the work. Should the Plumbing Subcontractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.

F. The Plumbing Subcontractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.

G. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of the Plumbing Subcontractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, the Plumbing Subcontractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Plumbing Subcontractor shall make all necessary changes in all affected related work provided under other Sections including location of roughing-in connections by other Trades, electrical

requirements, piping, supports, insulation, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.

H. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. Equipment and materials shall be products which will meet with the acceptance of the Authorities having jurisdiction over the work and as specified hereinbefore. Where such acceptance is contingent upon having the products listed or labeled by FM, UL or other testing laboratories, the products shall be so listed or labeled. Where no specific indication as to the type or quality of material or equipment is indicated, a first class standard article shall be provided.

I. All equipment of one type (such as valves, piping, heaters, water system components, drainage specialties, etc.), shall be the product of one manufacturer.

J. Equipment furnished by the Owner, if assigned to the Plumbing Subcontractors, shall be received, inspected, installed, etc., as if they were purchased by the Plumbing Subcontractor. All guarantees, service contracts, etc., shall be the same as for all other equipment provided under this Contract. Make all connections, and provide all piping and controls as necessary.

1.11 CUTTING AND PATCHING

A. The Plumbing Subcontractor shall be responsible for all core drilling, as required for work under his Contract, but in no case shall he cut into any structural elements without the written approval of the Architect.

B. All cutting, rough patching and finish patching shall be provided under this Contract.

C. All concrete and masonry equipment bases and pads shall be provided by the Other Work Contractor.

1.12 USE OF PREMISES

A. The Plumbing Subcontractor shall confine all of his apparatus, storage of materials and construction to the limits indicated on the drawings and directed by the Architect and he shall not encumber the premises with his materials.

B. In storing materials within areas (structure or ground), or when used as a shop, the Plumbing Subcontractor shall consult with the other work Contractor and shall restrict his storage to space designated for such purposes. The Plumbing Subcontractor will be held responsible for repairs, patching or cleaning arising from any unauthorized use of premises.

C. Notwithstanding any approvals or instructions which must be obtained by the Plumbing Subcontractor from the Architect in connection with use of premises, the responsibility for the safe working conditions at the site shall remain the Plumbing Subcontractor's and the Architect or Owner shall not be deemed to have any responsibility or liability in connection therewith.

1.13 PROTECTION

A. All materials such as valves, fittings, piping, etc., shall be properly protected and all piping openings shall be temporarily closed by the Plumbing Subcontractor installing same, so to prevent obstruction and damage. The Plumbing Subcontractor shall take precautions to protect his materials from damage and theft.

B. The Plumbing Subcontractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or electrical systems provided under his Contract.

1.14 DAMAGE TO OTHER WORK

A. The Plumbing Subcontractor shall be held responsible and shall pay for all damages caused by his work to the new building structures and equipment, piping, etc., and all work and finishes installed under this Contract in the new or in existing building. Repair of such damage shall be done as hereinbefore specified, at the expense of the Plumbing Subcontractor and to the Architect's satisfaction.

1.15 CORRECTION OF WORK

A. The Plumbing Subcontractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after completion of work and whether or not fabricated, installed or completed. The Plumbing Subcontractor shall bear all costs of correcting such rejected work.

B. The above requirements will also apply to work observed to be in conflict with 15400-1.8 "Coordination of Work" as it relates to installations not allowing accessibility to all system components.

1.16 EXTRA WORK

A. No claim for extra work will be allowed unless it is authorized by the Architect in writing before commencement of the extra said work.

1.17 TOUCH-UP PAINTING

A. The Plumbing Subcontractor shall thoroughly clean all equipment and systems provided under this Contract from rust, splatters and other foreign matter or discoloration, leaving every part of

each system in an acceptable prime condition. The Plumbing Subcontractor, for the work under his Contract, shall refinish and restore to the original condition all equipment and piping which has sustained damage to the manufacturer's prime and finish coats of paint and/or enamel.

1.18 PIPE SLEEVES, PLATES AND ESCUTCHEONS, FIRESTOPPING AND SMOKEPROOFING

A. **Where pipes pass through all walls and floors**, the Plumbing Subcontractor shall provide and set individual sleeves for each pipe and all other work under his charge, as necessary for passage of all pipes. Sleeves shall be of sufficient size to provide 1/2" air space around the pipe passing through (including insulation where pipes are insulated). Where pipes are to be insulated, insulation shall run continuous through sleeves. All openings shall be sealed, smokeproofed and made tight. The Plumbing Subcontractor shall be responsible for the exact location of sleeves provided under this Contract and shall coordinate all requirements for piping sleeves.

B. The Plumbing Subcontractor, for work under his charge, shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation, and he shall prepare sleeving and opening drawings for the use of these drawings by the other work contractor.

C. Sleeves and inserts shall not be used in any portions of the building, where their use would impair the strength or construction features of the building. Elimination of sleeves must be approved by the Architect.

D. Provide chrome-plated brass escutcheons with set screw for exposed piping, in all areas except in mechanical rooms. In these areas use plain brass or cast iron escutcheons suitable for painting. All escutcheons shall be sized to fit the bare pipe or insulation in a snug and neat manner. They shall be of sufficient size to cover sleeved openings for the pipes and of sufficient depth to cover sleeves projecting above floors. Escutcheons shall be as manufactured by Beaton & Caldwell, Dearborn Brass or Grinnell.

E. Pipe sleeves shall be required on **all** pipes passing through all walls and shall be made of Schedule 40 pipe, 16 gauge galvanized steel or 16 gauge steel as follows:

1. Sleeves on pipes passing through masonry or concrete construction shall be Schedule 40 pipe.
2. Sleeves on pipes passing through drywall construction shall be 20 gauge galvanized steel.
3. Sleeves on pipes passing through fire rated drywall partitions shall be 16 gauge steel.
4. Exterior wall sleeve through masonry walls shall be made watertight by the use of Mechanical Link Seal Joint as MFG by Century Products MFG.

F. Pipe sleeves shall be set as follows:

1. Set sleeves 1" above finish floor (3" at mechanical rooms) and flush on each side of walls, except sleeves through floor occurring in walls and partitions shall terminate 1" above the finished floor.
2. Sleeves shall be set securely in place before concrete is poured.

G. The Plumbing Subcontractor shall firestop or smokestop the space between the sleeves provided under his Contract and pipes as applicable, as follows:

1. Materials shall bear label issued by qualified laboratory and specifically indicating that the product has been tested to ASTM E814 Standard, shall be as manufactured by Bio Fireshield Inc. or Dow Corning Corp., and shall include the following:

    a. Dow Corning silicone RTV foam (penetration fill material) complete.
    b. Dow Corning 96-081 RTV silicone adhesive sealant.
    c. Mineral fiber board, mineral fiber matting, and mineral fiber putty may be utilized for forming and damming materials used to contain the liquid silicone RTV foam mixture prior to and during foam-filling penetrations. Damming and forming materials shall be fire tested and functionally approved and shall be capable of being left in place to become an integral part of the foamed penetration wall.

2. Materials shall be delivered in their original, tightly sealed containers or unopened packages, all clearly labeled with the manufacturer's name, product identification and lot numbers where appropriate.

3. Installation shall comply with the following:

    a. Penetration seal preparation shall include use of the procedures, techniques and quality control standards recommended by the product manufacturer, as follows:
    b. Remove all incidental combustible materials and loose impediment from the penetration opening and involved surfaces.
    c. Remove free liquids or oil from all involved surfaces and penetration components.
    d. Install the specified damming materials to accommodate and insure the proper thickness/fire rating requirements and provide containment during foaming.
    e. Foam mixing and dispensing of equipment and materials shall be in strict accordance with manufacturer's instructions.

4. The materials installation procedures, clean-up, safety precautions and requirements shall be in accordance with Dow Corning published information relative to "Safe Handling Procedures", use of safety shoes, goggles, etc.

5. All firestopping materials must be applied in direct accordance with their UL label certification.

6. The Plumbing Subcontractor shall submit a mockup of every type of firestopping method used on this project for approval by the Architect at the site. The firestopping methods must be approved prior to installation of systems.

H. Except as otherwise specified, underground piping passing through exterior walls, foundation slabs on grade, or manhole walls, shall have penetration closures of the modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous belt around the pipe and with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between the pipe and wall, reducing chances of cathodic reaction between these members. The Plumbing Subcontractor for work under his charge shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation. The inside diameter of the wall opening shall be sized to fit the pipe and ensure a watertight joint. Where applicable, when installing seals, take into account the pipe O.D. if non-standard due to coating or jacketing.

1.19 WATERPROOFING, FLASHING AND COUNTERFLASHING

A. Unless specifically indicated otherwise on the drawings, the Plumbing Subcontractor shall provide all counterflashing and waterproofing of all piping and equipment provided by him, which pierce roofs, walls and other weatherbarrier surfaces. All work under this Section shall be coordinated with the Other Work Contractor.

B. All work shall be performed in a workmanlike manner to ensure weatherproof installation. Any leaks developed due to this Contractor's work shall be repaired at his expense, to the Architect's satisfaction.

C. Pipes passing through slabs shall have the sleeve extended above floors as hereinbefore specified to retain any water and the space between the pipe and sleeve caulked with lead wool. The top shall be sealed with lead and the bottom shall be sealed with monolastic caulking compound.

D. Subcontractor shall provide and install counterflashing to overlap the base flashing by 4". Flashing shall be fastened with matching clamp rings or by brazing, welding or soldering.

1.20 MISCELLANEOUS IRON AND STEEL

A. The Plumbing Subcontractor shall provide all steel supports and hangers as shown on the drawings or required to support all equipment, systems or materials provided under this Contract.

B. All work shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets and framework shall be properly sized and strongly constructed.

C. Measurements shall be taken on the job and worked out to suit adjoining and connecting work. All work shall be done by experienced metal-working mechanics. Members shall be straight, true and accurately fitted.

D. Welded joints shall be ground smooth where exposed. Drilling, cutting and fitting shall be done as required to properly install the work and accommodate the work of other Trades as directed by them.

E. Members shall be generally welded except that bolting may be used for field assembly where welding would be impractical. Welders shall be skilled and certified. Bolts, nuts and washers shall be high tensile type, minimum 3/4" diameter, conforming to ASTM.

F. All shop and field fabricated iron and steel work shall be cleaned and dried and given (1) coat of rust inhibiting paint on all surfaces and in all openings and crevices.

1.21 ELECTRICAL WORK, MOTORS, MOTOR CONTROLLERS

A. The Electrical Subcontractor shall provide power wiring to all equipment provided under Section 15400. All control wiring shall be installed in conduits and in accordance with the respective equipment manufacturer requirements. All connections shall be provided by the Plumbing Subcontractor. All conduit and wiring provided by the Plumbing Subcontractor shall be installed in accordance with the requirements of Section 16100 of these Specifications.

B. Motors shall be built in accordance with latest Standards of NEMA and as specified. Motors shall be specifically and expressly wound for voltage required.

C. Motors shall be tested in accordance with ANSI 50 and conform thereto for insulation resistance and dielectric strength.

D. Motors shall be provided with adequate starting and protective equipment as specified or required and with conduit terminal box of size adequate to accommodate conduits and wires.

E. Capacity shall be sufficient to operate motors under job conditions of operation and load, without overload and shall be at least the horsepower size indicated or specified.

F. All motors shall be suitable for continuous duty at rated horsepower, with temperature rise not to exceed 40°C for dripproof motors, 50°C for splashproof motors, 55°C for totally enclosed motors. All motors shall be capable of 15% overload without overheating.

G. Direct connected motors shall be furnished with adjustable base. Motors connected to driven equipment by belt or shaft shall be furnished with adjustable sliding bases, except for fractional motors which shall be furnished with slotted mounting holes.

H. Motors smaller than 1/2 HP shall be capacitor, starter or split-phase type. Motors 1/2 HP and larger shall be squirrel cage, induction type. Motors 1 HP and larger shall have grease lubricated ball bearings and approved grease fittings.

I. All electrical apparatus and controls furnished as a part of the plumbing work shall conform to applicable requirements under Electrical Section.

J. The Plumbing Subcontractor shall provide the Electrical Subcontractor with all motor size and wiring requirements within (15) days from date of Contract to allow proper coordination of Trades by the other work Contractor.

K. The Plumbing Subcontractor shall verify with the Electrical Subcontractor available electrical characteristics before ordering any equipment or motors.

L. Equipment which includes a number of correlated electrical control devices mounted in a single enclosure or on a common base with equipment, shall be supplied for installation completely wired internally with terminal strip ready for external wiring. Unless specifically directed otherwise in the Contract Documents, if these control devices are separately mounted they shall be furnished by the Plumbing Subcontractor and wired by Electrical Subcontractor in accordance with the manufacturer's wiring diagram, as shown on the drawings and as specified hereinafter.

1.22 IDENTIFICATION OF MATERIALS

A. All equipment used in the plumbing systems shall have a permanently attached nameplate identifying the manufacturer, service, size, serial number or model number, etc. The nameplates shall be kept clean and readable at all times.

B. Each item of equipment such as pumps, air compressors, vacuum pumps, etc., shall be identified by a permanently attached nameplate made of black surface, white core laminated bakelite with 1" high indented letters. Nameplates shall be minimum 5" long by 3" wide and bear the equipment name as designated in the specifications. Nameplates shall be as fabricated by Seton Nameplate Co., Atlantic Engraving Co., W.H. Brady Co., or approved equal. Attach with screws or rivets only.

C. A legend showing the service and an arrow indicating the direction of flow shall be applied on each pipe installed by the Plumbing Subcontractor. Indication shall be by stencil and paint only, no "stick-ons" will be allowed.

D. The piping of each system shall be identified in the following locations and where directed by the Architect.

1. Pipe mains and branches - every 15’-0”.
2. At each valve.
3. Each wall penetration (both sides).
4. Each riser including branch risers from mains.
5. At each piece of equipment.

E. The identification of piping shall be coordinated with the Owner and comply with OSHA and ANSI A13.1 Standards for the identification of systems. Obtain approval of Architect prior to

installation. The letter size and background color shall conform to the ANSI Scheme for the Identification of Piping Systems.

F. Provide all labels on all vents thru roof.

G. Close attention shall be paid to all vent piping including that piping which penetrates roof. - This piping must be identified, including all vent penetration through the roof.

1.23 VALVE TAGS, NAMEPLATES AND CHARTS

A. All valves on pipes of every description shall be provided with neat circular brass valve tags of at least 1 1/2" in diameter, attached with brass hook to each valve stem or handle as determined by Architect. Tags shall be provided by the Plumbing Subcontractor for the work under his charge. Stamp on these valve tags, in letters as large as practical, the number of the valve and the service, such as "HW", "HWC", "CW", ", for hot water, hot water circulation, cold water. The numbers of each service shall be consecutive. Obtain approval of Architect prior to installation. All pipe system valves to be tagged.

B. All valves on equipment shall be numbered by 3" red metal discs with 2" high white numbers secured to stem of valves by means of brass hooks or small link brass chain.

C. These numbers shall correspond to numbers indicated for valves on the Record Drawings and on (2) printed detailed lists. These printed lists shall state the numbers and locations of each valve and the equipment or system which it controls and other necessary information such as requiring the opening or closing of another valve or valves when any one valve is to be opened and closed.

D. These printed lists shall be prepared in form to meet approval of the Architect and shall be framed under glass. Provide valve lists in booklet form also and submit (6) copies to the Architect.

E. Nameplates, catalog numbers and rating identification shall be securely attached to mechanical equipment with screws or rivets. Adhesives or cements will not be permitted.

F. The Plumbing Subcontractor shall provide for his work all valve charts including his name and telephone number; date of chart; name and telephone number of Architectural Firm and Consulting Mechanical Engineering Firm and the Owner's representative.

G. This information must be submitted on electronic file format also.

1.24 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

A. The Plumbing Subcontractor shall thoroughly instruct the Owner's operating personnel, to the complete satisfaction of the Architect, in the proper operation of all systems and equipment provided by him. The Plumbing Subcontractor shall make arrangements, via the Other Work Contractor, as to whom the instructions are to be given in the operation of the basic and auxiliary systems and the periods of time in which they are to be given. The Architect and Owner shall be

completely satisfied that the Owner's representative has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by the Plumbing Subcontractor to the Owner's representative, then the Plumbing Subcontractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this paragraph of the specification has been complied with. All time required for Owner's instruction to satisfy the above requirements shall be included in this Contract. No extra compensation for such instructions will be allowed.

B. The Plumbing Subcontractor shall submit to the Architect for approval, a total of (6) typed sets, bound neatly in 3-ring loose-leaf binders, of all instructions for the installation, operation, care and maintenance of all equipment and systems. Information shall indicate possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each section such as valves, water boosters, pure water systems, etc., shall be clearly divided from the other sections. A sub-index for each section shall also be provided. The methodology of setting-up the manuals shall be submitted to the Architect and Owner through the Contractor for approval prior to final submission of manuals.

C. The instructions shall contain information deemed necessary by the Architect and shall include, but not be limited, to the following:

1. Instructional classes on equipment and systems operation for Owner's representative and maintenance personnel, by engineering staff of Plumbing Subcontractor. Minimum of ten (10) hours of instruction. Instruction shall include:

    a. Explanation of manual and its use.
    b. Summary description of the plumbing systems.
    c. Purpose of systems.

    All training classes and equipment instruction shall be videotaped on VHS format by the Plumbing Subcontractor. Provide (3) copies of all tapes to the Owner and one to the Architect. At the Owner's discretion, the Plumbing Subcontractor provide ten (10) additional hours of instructions up to one year after the building has been occupied.

2. System

    a. Detailed description of all systems.
    b. Illustrations, schematics, block diagrams, catalog cuts and other exhibits.

3. Operations

    a. Complete detailed, step-by-step, sequential description of all phases of operation for all portions of the systems, including start-up, shutdown, adjusting and balancing. Include all posted instruction charts.

4. Maintenance

a. Parts list and part numbers.
b. Maintenance, lubrication and replacement charts and Contractor's recommendations for preventive maintenance, as applicable to his work.
c. Troubleshooting charts for systems and components.
d. Instructions for testing each type of part.
e. Recommended list of on-hand spare parts.
f. Complete calibration instructions for all parts and entire systems.
g. Instruction for charging, filling, draining and purging, as applicable.
h. General or miscellaneous maintenance notes.

5. Manufacturer's Literature

a. Complete listing for all parts.
b. Names, addresses and telephone numbers.
c. Care and operation.
d. All and only pertinent brochures, illustrations, drawings, cuts, bulletins, technical data, certified performance charts and other literature with the model actually furnished to be clearly and conspicuously identified.
e. Internal wiring diagrams and engineering data sheets for all items and/or equipment furnished under each Contract.
f. Guarantee and warranty data.

6. The Plumbing Subcontractor shall furnish instructions for lubricating each piece of equipment installed by him. Instructions shall state type of lubricant, where and how frequently lubrication is required. Frame instructions under glass and hang in a location as directed by Architect.

7. Information must be submitted on electronic file also

1.25 MANUFACTURER'S REPRESENTATIVE

A. The Plumbing Subcontractor shall provide, at appropriate time or as directed by the Architect, the on-site services of a competent factory trained Engineer or authorized representative of particular manufacturer of equipment such as for the domestic water booster pump, ejectors, hot water heater, pumps, etc., provided under this Contract, to instruct the Owner, inspect, adjust and place in proper operating condition any item provided by him, as applicable. A minimum, system start-up shall start 90 days prior to scheduled building occupancy or at construction managers discretion.

B. The Plumbing Subcontractor, as applicable, shall start-up and set in operating condition all major equipment and systems, such as the domestic water booster pump, water heaters, ejectors, well

water pumps, etc., in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. In no case will major systems and equipment be activated by any of the Subcontractor's, without the assistance or presence of the equipment manufacturer representative.

C. A written report shall be issued by the particular equipment manufacturer and the Plumbing Subcontractor summarizing the results of the commissioning and performance of each system for the Architect's record. No additional compensation will be allowed for any Contractor for such services.

1.26 CONNECTIONS TO EQUIPMENT

A. The Plumbing Subcontractor shall provide all pipe connections to equipment provided under other Sections of the specifications as shown on the Architectural Planning, and/or plumbing drawings and herein specified (sterilizers, autoclaves, ice machines etc.), including final connections to equipment, to result in a complete system, fully operational. The Plumbing Subcontractor shall also make connections to Owner furnished or relocated equipment as specified above. Coordinate location of all equipment with Architect and Other Work Contractor. Obtain installation diagrams and methods of installation of all equipment, from manufacturers. Follow instructions strictly. If additional information is required, obtain same from Architect.

1.27 COORDINATION DRAWINGS

A. Before materials are purchased, fabricated or work is begun, each Subcontractor shall prepare coordination drawings for all floors/areas, including buried systems/services (all-Trade-composite at 3/8 inch scale), showing the size and location of his equipment and lines, in the manner described herein under General Requirements - Section 01040.

B. Coordination drawings are for the architect’s use during construction and shall not be construed as shop drawings or as replacing and shop drawings. The coordination drawings, when corrected for actual “as-built” conditions, will be reviewed by the Architect, corrected and become the Record Drawings to be submitted to the Owner for his use.

C. The cost of producing and reproducing the drawings will be included under the Contract of each Trade, including the cost or preparation of the Architectural building outlines. The HVAC Contractor shall take the lead to produce the Architectural backgrounds, show all ductwork, piping, etc., and circulate the drawings to any of his Subcontractors and the other Trades (Plumbing, Fire Protection, Electrical), so that they can indicate all their work as directed by the Architect as required, to result in a fully coordinated installation.

D. In addition to the regular coordination drawing review, the plumbing work will also be reviewed by the Architect/Engineer to ensure that the system and equipment arrangements are suitable to provide maintenance access and service as follows:

1. Valves and instrumentation should be grouped where possible and positioned in accessible locations.

E. Prepare a complete set of computer based AutoCad 2005 drawings at scale not less than 3/8" equals 1'-0", showing basic layout for the structure and other information as needed for preparation of Coordination Drawings. The drawings shall indicate the layout of all specialty tradework as indicated herein and shall be designated as Coordination Drawings. The Contractors can purchase a copy of the floor plans on disk from the engineer to assist in the preparation of Coordination Drawings. The Contractor shall provide a minimum of two (2) weeks notice to the engineer for the preparation of the disk. A signed liability release form will be required from the Contractor prior to the release of the disk from the engineer.

F. Highlight all fire rated partitions on the Coordination Drawings for appropriate coordination.

G. The main paths for the installation or removal of equipment from mechanical and electrical rooms shall be clearly indicated on the Coordination Drawings.

H. Each of the specialty trades shall add its work to the base drawings with appropriate elevations and grid dimensions. Specialty trade information shall be required for mechanical rooms, horizontal exits from plumbing closets, crossovers and for spaces in the above ceilings where congestion of work may occur such as corridors and, where required, entire floors. Drawings shall indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions and other services. Indicate elevations relative to finish floor for bottom of ductwork and piping and conduit 6" greater in diameter.

1. Specialty Trade shall include:

    a. Plumbing system.
    b. HVAC piping and equipment
    c. Electrical
    d. Sheet Metal Work
    e. Sprinkler System
    f. ATC system
    g. Medical/ Dental gas & vacuum

I. Upon completing their portion of the Coordination Drawings, each specialty trade shall sign, date and return Coordination Drawings to the Contractor.

J. Where conflicts occur with placement of materials of various trades, the General Contractor shall be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialized and dated by the affected specialty trade subcontractor. The General Contractor shall then final date and sign each drawing.

K. Fabrication shall not start until Coordinate Drawings have been distributed to all parties as indicated herein.

L. Format: Coordination Drawings (plans only) shall be done using CAD in AutoCAD 2005 in either IBM or Mac Format, disks shall be given tot he architect for future transfer to Owner. Coordination Drawings will be used as base for as-built drawings.

M. Distribution of Coordination Drawings:

1. The General Contractor shall provide one print of each Coordination Drawing to:

    a. Each specialty trade Subcontractor.
    b. Owner
    c. Construction Manager
    d. Architect (for record purposes).

N. After distribution:

1. The method used to resolve interferences not previously identified shall be as in paragraph F. above. Distribute revised Coordination Drawings to all parties listed above.

O. Coordination Drawings include but are not necessarily limited to:

1. Structure
2. Partition/room layout, including indication of smoke and fire resistance rated partitions.
3. Ceiling layout and heights
4. Light fixtures.
5. Access Panels
6. Sheet metal, heating cols, boxes, grilles, diffusers, etc.
7. All heating piping and valves.
8. Smoke and fire dampers.
9. Soil, waste, vent piping, and conductor
10. All water systems.
11. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit. Motor control centers, starters and disconnects.
12. Sprinkler piping and heads.
13. All equipment, including items in the Contract as well as O.F.C.I. and O.F.I. items.
14. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur indicates areas in which the required access area may be greater than the suspected grid systems.
15. Medical Gas Systems

1.28 RECORD DRAWINGS

A. The Plumbing Subcontractor shall maintain current at the site a set of his drawings on which he shall accurately show the actual installation of all work provided under his Contract indicating any variation from the Contract Drawings, in accordance with the General Conditions and Supplementary General Conditions. Changes whether resulting from formal change orders or other instructions issued by the Architect shall be recorded. Include changes in sizes, location and dimensions of piping, equipment, etc.

B. Utilizing the coordination drawings described herein before, the Plumbing Subcontractor shall modify/correct/edit the plumbing work on the above CAD coordination drawings, to obtain a "CAD" set of Record Drawings. Also include (2) blackline prints, and CDX CAD files of entire record drawings..

C. A marked-up and colored-up set of prints on-site will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner's representatives and they shall be corrected if found either inaccurate or incomplete. This procedure is mandatory.

D. Coordination drawings are for the Contractor's, Architects and Owner's use during construction and shall not be construed as replacing any shop drawings. The CAD coordination drawings, when corrected for actual "as-built" conditions, will be reviewed by the Architect, corrected and will be used to formulate the Record Drawings to be submitted to the Owner for his use.

E. The Plumbing Subcontractor shall submit a set of CAD files on disc marked "AS-BUILTS". All costs associated with the production and reproduction of the CAD files shall be included under the plumbing bid for work under the plumbing contracts.

1.29 ELECTRICAL ROOM REQUIREMENTS

A. The Plumbing Subcontractor shall not install any piping or equipment in or through electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms, unless piping or equipment is intended to serve these rooms. If the Plumbing Subcontractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.

B. Where piping carrying liquid or gas is routed to within 12" of any electrical panels or packaged equipment controllers, the Plumbing Subcontractor shall provide galvanized sheet metal drain pans below such piping. The drain pans shall be constructed of minimum 18 gauge G-90 galvanized sheet metal with all joints sealed watertight. Extend 1 1/4" copper drain piping, with dielectric union to nearest floor drain.

1.30 HOISTING EQUIPMENT AND MACHINERY

A. All hoisting equipment and machinery required for the proper and expeditious prosecution and progress of the work under this Contract shall be furnished, installed, operated and maintained in safe condition by the Plumbing Subcontractor for his material and/or equipment delivered to the designated hoisting area. All costs for hoisting operating services shall be borne by the Plumbing Subcontractor, for all equipment and work under his charge.

1.31 STAGING

A. All staging, exterior and interior for Plumbing work shall be furnished and erected by the Plumbing Subcontractor and maintained in safe condition by him for proper execution of his work.

1.32 SUBMITTALS

A. Prepare and submit shop drawings in accordance with the requirements hereinbefore specified, and of Division 0 and applicable parts of Division 1 and in the manner described therein, modified as noted hereinafter.

B. All shop drawings shall have clearly marked the appropriate specification number, drawing designation, project name, etc., for identification of the submittal.

C. Disposition of shop drawings shall not relieve the Plumbing Subcontractor from the responsibility for deviations from the drawings or specifications, unless he has submitted in writing a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Architect, nor shall such disposition of shop drawings relieve the Plumbing Subcontractor from responsibility for error in shop drawings or schedules.

D. Shop drawing data shall include, but not be limited to, the following:

1. Manufacturer's model and catalog data.
2. Complete connection diagrams for all Trades.
3. Dimensions, capacities, ratings, materials, finishes, etc.

E. Each shop drawing is required to bear the review stamp of each Contractor associated with installing the equipment and/or processing the document.

F. Shop drawings shall include, but shall not be limited to, the following:

1. Plumbing work layout, including location and sizes of piping, valves, drains, and all other accessories.
2. Equipment Cuts For:

a. Valves, gauges, drains, piping, fixtures, trim.
b. Hangers, supports, insulation, and identification.
c. Access panels.
d. Backflow prevention devices.
e. Domestic water heaters and circulation pumps.
f. Insulation
g. Seismic bracing
i. Mixing valves
j. Piping
k. Heat tracing
l. Water meters
m. Plumbing fixtures

1.33 TOILET ACCESSORIES

A. Attention is called to Division 10, the specialties section of the specification, specifically Section 10800 Toilet Accessories. All toilet room accessories, including grab bars at handicapped fixtures, shall be furnished under Section 10800 of the Specifications. The labor for installing all toilet room accessories and all backup material of wood, fasteners, hangers, brackets, etc. shall be borne by the Plumbing Contractor. Reference shall be made to Architectural Specifications and drawings for exact quantity, type, elevation and locations of toilet accessories. Accessories must be properly fastened with special attention given handicapped persons grab bars, etc. which must

be anchored in accordance with manufacturer's instructions. Store accessories until required on the job. Moving materials onto project site as required is the responsibility of this Subcontractor.

1.34 PIPE COVERING PROTECTOR

A. Where exposed pipe covering occurs on pipes rising and/or dropping to fixtures and equipment passing through floors, walls, partitions, and ceilings, there shall be installed in addition to the iron pipe size sleeve, a 24 gauge split pattern spun aluminum, stainless steel or chrome plated brass pipe covering protector at the ceiling, wall, bottom of the vertical drops and at the floor and shall rest on the pipe sleeve. The covering shall recede into those protectors at least 1-1/2", except where covering is to be carried all the way through sleeve. Provide protection saddles under all hangers.

1.35 CROSS AND INTERCONNECTIONS

A. No plumbing fixtures, equipment, device or piping shall be installed which will provide a cross or interconnection between a distributing supply or a drainage system or a soil or waste pipe which will permit or make possible the backflow of sewage, polluted water or waste into the domestic water supply system.

1.36 CORE DRILLING

A. This subcontractor shall perform all core drilling required for the proper installation of the plumbing system. Locate all required openings and prior to coring coordinate the opening with the General Contractor. Thoroughly investigate the existing conditions in the vicinity of the required opening prior to cutting. Care must be taken so as to not to disturb the existing hospital systems. Locate all other openings required for the General Contractor. All cored openings are to be by Plumbing Contractor and all other openings are by the General Contractor. Patching of existing walls and openings shall be preformed by the respective trade responsible for the finish material in which the opening is made.

B. All core drilling locations must be approved by the Owner.

PART 2 – MATERIALS

2.0 HANGERS AND SUPPORTS

A. All piping shall be supported from the building structure by means of approved hangers and supports. Piping shall be supported to maintain required grading and sloping of lines, to prevent vibration and to secure piping in place, and shall be so arranged as to provide for expansion and contraction.

B. Maximum spacing of hangers on runs of steel, copper or brass piping shall be as follows:

Schedule - Hanger Spacing in Feet/Pipe Material

Pipe Size (inches)	Steel	Copper or Brass
(a) ½	7	5
(b) ¾	7	5
(c) 1	7	5
(d) 1¼	10	6
(e) 1½	10	8
(f) 2	10	8
(g) 2½	12	10
(h) 3	12	10
(i) 4	12	10
(j) 5	12	10
(k) 6	12	10
(l) 8	12	10

C. Maximum spacing on cast iron soil pipe and acid resistant waste pipe shall be 5' and hangers shall be provided at all changes in direction. Hanger rods to support piping from the structure or supplementary steel shall not exceed 4' in total length. Where pipe support assemblies exceed 4' in total length, this Subcontractor shall furnish and install factory fabricated channels and associated accessories.

D. Where codes having jurisdiction require closer spacing, the hanger spacing shall be as required by code in lieu of the distances specified herein.

E. Hangers in general for all horizontal cast iron piping shall be clevis type hangers. These hangers shall be sized to provide for insulation protectors as hereinbefore specified.

F. Hangers for uncovered (un-insulated) copper and brass piping shall be factory applied plastic coated steel band.

G. Where three or more pipes are running parallel to each other, factory fabricated gang type hangers with the pipe saddle clips or rollers shall be used in lieu of the hereinbefore specified clevis hangers. These hangers shall be sized to provide for insulation protectors as hereinafter specified. Pipe saddle clips shall be not less than 16-gauge metal and shall be plastic coated when installed with un-insulated copper piping or plastic piping. All piping to be supported from Unistrut type hanger.

H. All vertical drops and runouts, including insulated pipes, shall be supported by extension type split ring type hangers. These hangers shall be plastic coated when used on uncovered copper tubing or plastic piping. Supports on insulated piping shall be sized to fit the outside diameter of the pipe insulation.

I. Field painting or spraying of hangers in lieu of plastic coating will not be accepted.

J. All hangers on insulated lines shall be sized to fit the outside diameter of the pipe insulation. Provide pipe covering protection saddles at all hangers on the insulated lines.

K. Remove rust from all ferrous hanger equipment (hangers, rods and bolts) and apply one coat of zinc rich coating immediately after erection.

L. Piping at all equipment and control valves shall be supported to prevent strains or distortions in the connected equipment and control valves. Piping at equipment shall be supported to allow for removal of equipment, valves, and accessories with a minimum of dismantling and without requiring additional support after these items are removed.

M. All piping installed under this SECTION of the Specification shall be independently supported from the building structure and not from the piping, ductwork, or conduit of other trades. All supplementary steel, including factory fabricated channels, required to meet the requirements specified herein, shall be furnished and installed by this Subcontractor.

N. All hangers shall be secured to approved inserts or expansion shields wherever possible and practicable. Drilling where required shall be done by this Subcontractor under this SECTION of the Specifications. The use of explosives for driving shields and inserts is prohibited.

O. Hangers for polypropylene piping as required by manufacturer.

P. Maximum spacing of hangers on runs of acid resistant pipe shall be as follows:

Pipe Size (inches)	Polypropylene
(a) 2,3,4	4'-6"

2.2 HOT WATER CIRCULATION PUMPS

A. Pumps: Furnish and install where shown on the plans, Bell & Gosset or TACO Mfg, duplex, all bronze horizontal centrifugal hot water circulation pumps for domestic water systems.

B. Control: Each pump shall be automatically controlled by a Minneapolis Honeywell, Marshall, or Powers Company, or approved equal L-4006A immersion aquastat which shall be installed in a suitable well, in the hot water circulation piping and shall be adjusted to start the circulating pumps at 5 degrees F above below or the normal operating temperature of the system. Thermometers shall be installed close to each aquastat with a 4 inch dial and range from 50 degrees F to 250 degrees F. Pumps shall have manual control also. Refer to hot water heater details.

C. Domestic Hot Water: 10gpm @ 12’ head – 1/4 HP – 120-V, 1 phase.

2.3 DOMESTIC WATER HEATER

2.4 INTERIOR VALVES FLANGES AND UNIONS

A. General: All systems under this Section shall be provided with valves to permit complete and/or sectional control of the system. They shall be located to permit easy operation, replacement and repair. They shall be installed where shown on the drawings, or as herein specified. They shall be the product of one manufacturer and shall be as manufactured by one of the following companies: Apollo, or Watts.

B. Water Valves

1. Water valves 2" and smaller shall be all bronze ball valves Apollo Series B-6800 with four bolt design, full port teflon seated ball and three piece valve body designed for 250 psi water.

2. Water valves larger than 2" and smaller than 3" shall be all bronze ball valves Apollo Series B-6400 with threaded ends designed for 250 pounds non-shock cold water.

3. Water valves 4" and larger shall be bronze mounted outside screw and yoke, solid wedge disc, flanged end Stockham F-667 250 iron body.

4. Drain valves shall consist of hose end drain valves, or ball valve with hose end adaptor, with bronze cap and chain.

5. Check valves shall be class 125 bronze bodied valves with bronze disc threaded cap, threaded ends by flanged ends where required by size.

6. Hot water circulation balancing valves shall be class 125 bronze with threaded ends. Globe valves with bronze discs, threaded cap. Flanged ends where required by size.

7. Provide reduced pressure backflow preventors as shown on the drawings, complete with control valves, repair kit, test kits, pressure gauges and air gap fittings, with drains piped to nearest floor drain. Valves shall be mounted 4'-0" centerline above the floor and properly secured to the wall or floor stand mounted. Devices shall be tested and certified under AWWA Std. No. C506 and FCCCHR of USC manual, Section 10.

    a. Backflow preventor on main domestic water service shall be WATTS 909 series or FEBCO Mfg reduced pressure zone device with FDA approved epoxy coated cast iron check valve bodies with bronze seats, FDA approved epoxy coated cast iron relief valve with stainless steel trim, bronze body ball valve test cocks, outside screw and yoke gate valves with resilient wedges and 909AG-K air gap fitting.

        1) Main water service – 909 OSY – Containment/Inplant
        2) Plumbing Equipment – 909-QT
        3) Hot water application – 909-HW-QT

8. In-line vacuum breakers for continuous pressure shall be Watts model N9C or approved equal, with bronze body, stainless steel working parts, rubber diaphragm and disc, 3/8" female inlet and outlet connections for in-line continuous pressure applications, polished chrome plated.

9. Backflow preventors with intermediate atmospheric vent shall be Watts 9D or approved equal all bronze construction with stainless steel internal parts, threaded union connections and built-in strainer, to be used for ice-maker connections and locations as called for on drawings.

C. Wall hydrants shall be equal toZurn-1310, with a chrome plated finish and integral backflow preventer.

D. Hose bibbs where indicated shall be chrome plated, hose and faucet valves with vacuum breakers, Chicago No. 952, or approved equal.

E. Trap primers for floor drains 2”, 3” and 4” shall be Pro Set Trap Guard System. Refer to manufacturers requirements for installation. Contact vendor at Tower Hill Sales 1-800-542-5554.

F. Flanges shall be companion type, faced and drilled for not less than 125# steam working pressure except flanges on portions of the water service that are subjected to pressures above 125# shall be 250# rated, and all shall be complete with necessary adapter, and shall be of size and material of adjacent piping.

G. Unions shall be suitable for working pressure of not less than 250 psi and shall be of size and material of adjacent piping. All threads shall be IPS to match connections

H. Trap primer valves for Mechanical Room Areas floor drains and open end drains trap primer distribution unit shall be Precision Plumbing Products Mosel PO-500 Oregon No. 1 Trap Primer Unit with Distribution DU-4 and Supply Tube SS-8 serving 4 drains. Provide all interconnecting piping.

I. Water pressure reducing valves shall be Watts all bronze with diaphragm protector – see schedule on drawings.

J. Master Thermostatic Water Mixing Valve Assemblies shall be Symmons or Leonard – see schedule on drawings.

K. Check valves on elevator sump pumps shall be non-slam weighted valves with arms.

L. Natural gas shutoff valves 2” and smaller shall be Eclipse bronze ball valve, 150 psig maximum working pressure. Over 2” size natural gas shutoff valves shall be Eclipse lubricated plug cocks, 175 psig maximum working pressure. Check valves on natural gas piping shall be Jamesbury disc type check valves, brass body, screwed ends, aluminum soft seated disc.

2.5 ACCESS PANELS

A. Group together valves, cleanouts, etc., concealed in suspended ceilings, walls and furred spaces to reduce the number of access panels, but all valves must be freely accessible for maintenance.

B. Furnish access panels of proper size to service concealed vales and other items, but in no case less than 24" x 24". Panels shall be of the proper type for material in which they occur to be furnished by this contractor. Panels to be installed by the trade subcontractor in whose work the panels occur.

C. Panels shall have flush doors with #14 USCG steel door and trim #USCG steel frame, metal wings for fitting into construction, concealed hinges and screwdriver operated stainless steel cam lock. Panels shall be shop coated with two coats of zinc chromate primer.

2.6 WATER METERS

A. Meter shall be approved by the Portland Water District. Meter to be fitted with OS&Y gate valves with cast iron body and bronze trim. Meter shall be provided with remote readout device and modem. Plumber shall include all costs and fees in the price of the work to provide and install all required components.

B Provide water meters on irrigation if required and after HVAC backflow preventers serving HVAC equipment.

2.7 PIPE MATERIALS

A. Cast Iron Soil Pipe and Fittings - Above ground soil, waste and vent conductor piping.

1. American manufacture no-hub cast iron soil pipe and fittings conforming to ASTM A74. Joints to be made with couplings consisting of stainless steel shield and clamp assembly and elastomeric sealing sleeve. Clamps shall be ANACO – HUSKY – SD-4000.

B. Cast Iron Soil Pipe and Fittings-Buried soil, waste, vent and conductor piping.

1. American manufacture service weight cast iron soil pipe and fittings conforming to ASTM A74. Joints shall be made with rubber resilient gasket push-on joints.

C. Copper Tubing and Fittings (Type L) - Water Piping (Domestic and Non-Domestic water).

1. Tubing to be Type L hard temper conforming to ASTM Specification No. B88-78. Fittings to be wrought copper conforming to ASTM B16.22. All joints shall be soldered with ASME Standard BWS/A5.8 lead free solder. Shall be used for all interior water piping.

2. May be used above ground for soil, waste and vent piping, and shall be used for forced main piping (unless noted on drawings) and shall be used for indirect waste piping and where space is limited or where called for on the drawings, except urinal waste piping shall remain cast iron. Fitting shall be made using 50-50 solder.

D. Ductile Iron Pipe and Fittings - Water Services

1. Thickness Class 52 cement lined ductile iron pipe conforming to AWWA C151-7, flanged ends.
2. Fittings shall be ductile iron, cement lined, 250 psi rating, flanged ends.
3. Shall be used for domestic water services outside of building. Shall be used for domestic service within building up to water meter for piping 8" in size.

E. Black Steel Piping and Fitting (Natural Gas)

1. Black steel pipe shall be Schedule 40 conforming to ASTM Designation A53 (seamless type). Fittings shall be black malleable (threaded or flanged) 150 pounds, conforming to ASA Designation B16.3. Shall be used for interior gas. Gas pipe dropping in concrete block walls shall be factory wrapped with corrosion resistant covering No. X-TRU coat or scotch kote.
2. All gas piping 4” and over and all buried gas piping shall joined by welded connections, except where detailed otherwise.

2.8 DRAINAGE SPECIALTIES

A. Before setting any drains, carriers, cleanouts or wall plates, obtain from the other work contractor the exact information relative to the finished grades of the top of the drains and partition locations. All drainage specialties shall be of the size noted on the drawings and shall be equal to the figure numbers scheduled below. Figure numbers are Zurn Company. Drainage specialties shall be Zurn.

B. Off the floor water closets shall be supported on adjustable closet fittings Z-1200-XH-CC series as required with cast aluminum true wall finishing frame. Extra heavy duty carrier – 500 lb. with cast iron coupling.

C. Urinal Carriers

1. Urinals shall be supported on Zurn Z1221 plate type system with block base foot supports.

D. Lavatory Carriers

1. Lavatories slab type - shall be supported on Zurn Z1231 concealed arm system with chrome plated threaded escutcheons and block base foot supports.
2. NOTE: All carrier foot supports shall be lagged to the floor slab.

E. Floor Cleanouts

1. Floor cleanouts shall consist of dura-coated cast iron body, inside caulk outlet, tapered threaded plug, adjustable nickel bronze top, Zurn or approved equal.

   For concrete floor - Zurn ZN1400
   For vinyl composite tile - Zurn ZN1400-X
   For carpeted areas - ZN1400-CM.
   For heavy traffic unfinished areas Zurn Z-1400 with cast iron top.

F. Wall Cleanouts

1. Zurn Model ZS1469 cast iron supreme cleanout tee with tapered threaded plug, round stainless steel access cover with securing screw.

G. Floor Drains (FD)

1. SEE DRAWINGS FOR LOCATIONS AND SCHEDULE

H. Roof Drains (RD)

1. SEE DRAWINGS FOR LOCATIONS AND SCHEDULE

2.9 WATER HAMMER SHOCK ABSORBERS

A. Zurn Z1700 Series or approved equal - stainless steel "shoktrols" shall be installed on water supply lines to plumbing connected equipment equipped with fast acting valves, such as sterilizers autoclaves, all batteries of plumbing fixtures with flush valves and the like to control water hammer. They shall be sized and selected in accordance with PDI Standard WH201 with access through approved access panels.

2.10 INSULATION

A. All piping and equipment installed under this Contract shall be covered as follows:

1. All domestic and non domestic cold water.
2. All domestic and non domestic hot water supply and re-circulation.
3. All horizontal conductor piping

B. Materials: The following materials are specified:

1. Water piping insulation - fiberglass.

2. Fittings and Valve Insulation:

a. Hydraulic setting combination insulating and finishing cement.
b. Molded or fabricated fitting covers of equal thickness and identical in composition to adjacent pipe insulation.

3. All materials, including vapor barrier jacket, glass cloth jackets, adhesives, etc., shall be fire retardant.

C. Insulation Thickness: The piping, fittings, and valves shall be insulated with the following minimum thicknesses:

1. Domestic and non domestic hot, circulating and tempered water piping, 3/4" thick up to 1" pipe size; over 1" pipe size shall be 1" thickness.

2. Domestic and non domestic cold water piping shall be 1/2" thick.

3. Horizontal conductor piping and waste piping below mechanical rooms and vertical drops from drain to offset and elbow at the end of the horizontal run, 1" thick with vapor barrier. Drainage piping, including drains may be insulated with two layers of vapor barrier blanket, 1" thick, minimum one pound density.

D. Finish:

1. Concealed Piping: Vapor barrier jacket on all water piping. Pre-sized glass cloth jacket may be used on hot water piping. Fittings shall be finished with pre-sized glass cloth jacket, PVC coverings, or fire retardant cloth.

2. Exposed Piping: Same as concealed, except all insulation shall have factory applied pre-sized glass cloth jacket, or all service jacket.

E. Application

1. General:

a. All insulation shall be installed in strict accordance with the manufacturer's recommendations and shall be applied by a qualified insulation contractor.

b. Coverings shall not be applied on any apparatus or piping until the apparatus and piping have been thoroughly cleaned, tested, and accepted as tight.

2. Piping: Pipe insulation shall be installed with vapor barrier jackets drawn tight and firmly sealed to assure a positive vapor seal. End joints shall be covered with 4 inch wide butt strips of material identical to vapor barrier jackets, and they shall be drawn tight and securely sealed. The use of staples, bands, etc., to secure insulation will not be accepted.

3. Fittings and Valves:

a. Cement or molded insulation on fittings and valve bodies shall be same thickness as adjacent covering and finish neatly to match the adjacent pipe insulation.

2.11 FIXTURES, EQUIPMENT, SUPPORTS, AND FASTENERS

A. All fixtures and equipment shall be supported and fastened in a satisfactory manner. Where wall hung fixtures are secured to masonry walls or partitions, they shall be fastened with 1/4" through bolts provided with nuts and washers at back. Bolt heads and nuts shall be hexagon and exposed bolts, nuts, washers and screws shall be chromium plated brass.

B. Where secured to concrete or brickwork walls, they shall be fastened with brass bolts or machine screws in lead sleeve type expansion shields and shall extend at least 3 inches into solid concrete brickwork.

C. Fixtures shall be American Standard Company and shall be installed complete with all trimmings and fittings as specified. Refer to architectural drawings for exact number and location of fixtures. Color of all fixtures to be white. Faucets shall be Delta Faucet unless noted.

D. Refer to the drawings for other fixture types and specifications.

2.12 SEISMIC BRACING

A. The Plumbing Subcontractor shall provide all necessary design and materials for seismic restraint and protection of piping and devices against damage where subject to earthquakes as required for the entire plumbing system within the building. All isolation and seismic devices shall be the product of a single manufacturer. Products of other manufacturers are acceptable provided their systems strictly comply with this section of the specifications. Provide isolation materials and seismic restraints complete and as manufactured by Mason Industries, Tolco or approved equal.

The work under this section shall include the design, furnishing and installation of all restraint devices and systems as may be required for the plumbing system including, but not necessarily limited to, the following:

1. All plumbing equipment and devices such as pumps, air compressors, tanks, etc.
2. All plumbing system piping as required.
3. Piping penetrations through floors and walls.
4. Sleeves with clearances around the outside, as recommended.
5. Equipment isolation bases.
6. Piping flexible connectors.
7. Seismic restraints for isolated equipment.
8. Seismic restraints for non-isolated equipment.
9. Certification of seismic restraint designs.

B. Submit ten (10) copies of descriptive data for all products and materials, including the following:

1. Catalog cuts and data sheets for the specific isolators, restraints and all other items to be utilized.
2. Details of methods of sleeving, plumbing, smokeproofing and isolation for pipes penetrating walls and slabs.
3. Specific details of seismic restraints and anchors, including number, size and locations for each piece of equipment.
4. Calculations to support seismic restraint designs.
5. All calculations, details and other submittal materials shall be sealed and signed by a structural or civil engineer registered in the state and qualified to perform seismic design calculations.
6. A seismic design liability insurance certificate that must accompany all submittals.

C. Code and standards requirements shall include, but not be limited to:

1. Applicable IBC with any additional State or Local requirements.
2. All State and Local codes.

D. Manufacturers working in this section must provide a seismic design liability insurance certificate and certify their ability to provide engineering and design as required by this section. This certificate shall be submitted to the Architect for review prior to any submittals.

2.13 BUILDING AUTOMATION SYSTEM

A The building automation system shall be furnished and installed under another section. This subcontractor shall provide dual contact pressure switches, tees, pipe wells, valves and caps to allow the connection from the BAS to the plumbing points required. The following table itemizes the equipment, location and type of device necessary to connect to the building automation system.

SERVICE OR EQUIP	PRESSURE	TEMP	FLOW	TROUBLE	CONTROL	LOCATION
Domestic Water Heaters		X			By BAS	Mech Rm Basement
Sewer Ejector Pumps				X	Contacts in Control Panel	Mech Rm Basement
Elevator Sump Pumps			X	X	Contacts in Control Panel	Elevator Machine Room

2.14 THERMOSTATIC MIXING VALVES

A. Furnish and install, as shown on the plans a thermostatic mixing valve for the domestic hot water systems as well as where shown on plans. Refer to drawings for schedule.

B. Provide bypass around all thermostatic mixing valve units.

2.15 ELECTRICAL CONTROL AND INTERLOCKING WIRING

A. The electrical contractor shall furnish and install power wiring 480/208 volt, 120 volt connection only to all plumbing connected equipment including panels and motors. This subcontractor shall mount panels and shall furnish and install all control and interlocking wiring for each piece of plumbing equipment including but not limited to local alarms for all plumbing equipment, pressure switches, flow switches and solenoid valves. All control wiring and interlocking wiring shall be installed in conduit and in accordance with the respective manufacturer's requirements

and all connections shall be provided by the plumbing subcontractor. Wiring and conduit provided by this subcontractor shall be installed in accordance with the requirements of SECTION 16000 of the specifications.

B. All electrical panels and life support panels shall be equipped with connection for emergency power hook-up.

2.16 SEWAGE EJECTOR

PART THREE - INSTALLATION

3.1 TESTING OF PIPING SYSTEMS

A. General

1. All piping systems shall be subjected to testing water, gas or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested, required head or pressure shall be maintained until all joints are inspected.
2. All tests shall be witnessed by the inspector having jurisdiction and the Architect/Engineer, with 48-hour notice given these authorities.
3. All equipment, material and labor required for testing any of the various systems or any part thereof shall be furnished by this Plumbing Subcontractor.

B. Sanitary, Waste and Vent, Roof Water Conductor Systems: Water test shall be applied to these drainage systems either in their entirety or in sections as required, after piping has been installed. If applied to the entire system, all openings in the piping system shall be tightly closed, except the highest opening, and the system filled with water to point of overflow. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section under test, and each section shall be filled with water but no section shall be tested with less than a 10' head of water. In testing successive sections at least the upper 10' of the next preceding section shall be tested so that no joint of piping in the building, except the uppermost 10' of the system, shall be submitted to a test of less than a 10' head of water. The water shall be kept in the system for at least 15 minutes before inspection starts; the system shall then be made tight at all points.

C. Any points of the drainage systems to be tested with air instead of water shall be made by attaching an air compressor testing apparatus to any suitable opening and after closing all other inlets or outlets, forcing air into the systems until there is a uniform gauge pressure of 5 psi or sufficient to balance a column of mercury 10" high. This pressure shall be held without the introduction of additional air for a period of at least 15 minutes.

D. All Water Piping Systems: Upon completion of all water supply systems or a section of them as required, they shall be tested and proved tight under a water pressure of 175 psi. Gauge should be located on the lowest new floor and pressure shall hold for a period of one hour without introducing additional water. The water used for testing shall be from a domestic water source of supply. Water piping before PRV’s and express riser set to 200 psi.

E. Defective Work: If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. All repairs to piping shall be made with new materials. No caulking of screwed joints or holes will be acceptable.

F. Provide 48-hour notice to hospital and authorities having jurisdiction of all test times, systems and procedures.

3.2 IDENTIFICATION

A. All labeling of piping, materials, and equipment, as outlined hereinafter for identification purposes, shall be performed by this Subcontractor.

B. The pipe markers shall be installed on the apparatus in full view and shall be a color that is in sharp contrast with the background. Color coding to be in accordance with the standards outlined in the American Hospital Association latest publication.

C. Before markers are applied, the apparatus shall be thoroughly cleaned and painted, if necessary.

D. Letters shall not be less than 1-1/2" in height. Arrows shall not be less than 9" long.

E. All water systems , sanitary piping systems exposed, above removable ceilings, and above furred spaces, shall be identified at intervals of approximately 20', at each change of direction and on both sides of walls for pipes passing through walls.

F. Piping systems shall be identified with approved snap-on covers designating services and direction of flow. Location of identification covers shall be near access panels wherever possible on both sides of valves. The markers shall be as manufactured by W.H. Brady Company, Westline Products, Seton Nameplate Company or approved equal.

G. Piping shall be labeled.

SYSTEM

Cold Water
Hot Water
Hot Water Circulation
Sanitary Waste and Kitchen Waste
Roof Drainage
Non-Domestic Water
Sanitary Vent

3.3 CORE DRILLING

A. All core drilling required for the installation of the plumbing systems is to be done by this Plumbing Subcontractor. This Subcontractor is to carry all costs for core drilling. The Construction Manager will not be responsible for any circular penetrations required for the proper installation of the plumbing systems. Locate all required openings and prior to coring, coordinate the opening with the Construction Manager and all other trades. Thoroughly investigate the existing conditions in the vicinity of the required opening prior to coring. This Subcontractor shall be responsible for damages to the building and its systems from the coring operations. Disturbances from coring shall be kept to a minimum.

3.4 SOIL, WASTE, VENT, AND CONDUCTOR PIPING

A. Pipes shall be plumb and parallel to building walls, beams, and columns. All horizontal lines are to be evenly pitched and properly secured with iron or steel hangers. A pitch of ¼" per lineal foot shall be maintained on all soil, waste, and conductor lines, wherever possible. Where long runs of piping require less pitch due to space restrictions, a less pitch shall be allowed on main lines 4" and over in size, but in no event should any pipeline have a slope less than 1/8” per lineal foot.

B. All soil pipelines shall be thoroughly put together with joints made with no-hub clamps. No hub clamps shall be torqued to manufacturer's recommendations.

C. All soil and waste pipes shall be carried out full size through the roof or connected to a common vent above the fixture and as shown on the drawings.

D. The main stacks of back ventilation shall run parallel and as close as possible to the soil pipe stacks and shall connect to the vent continuation of the soil stack at least 3" above the rim of the highest plumbing fixtures on the stack; vent stacks shall also be dripped into the bottom of the soil stack through a Y and _ bend on an upright Y fitting. Offsets in vent pipe shall be made with 45 degree fittings wherever possible. Horizontal vent lines shall pitch toward a waste line.

E. Threaded joints shall have American National taper screw thread with graphite and oil compound applied to the male threads.

F. Piping to be run straight and plumb and all offsets shall be made at an angle of not less than 45 degrees and all threaded joints shall be as specified above.

G. Carefully lay out the work in advance so that the pipes will pass through the opening and permit the proper pitch to the pipelines. Due to the extensive system of ventilation and lighting systems, it will be necessary for all trades to properly coordinate their work with the work of other trades so as to avoid the necessity of taking down work installed without prior checking.

3.5 CLEANOUTS

A. Provide and connect cleanouts with brass caps and screws same size as pipe up to 4" and not less than 4" for larger piping at the ends of all branches on soil and waste piping, and in such other portions of the piping where run is over 50 feet. Underfloor cleanouts shall be installed as detailed. Special attention is called to cleanouts in carpeted areas. Cleanouts shall have special carpet marker.

B. Where stacks enter drains near walls or piers causing difficult access to end cleanouts, there shall be a vertical cleanout on the stack just above the floor with a 1/4 bend at the foot of the stack.

C. Where such conditions occur in walls or partitions, the cleanout cover shall be accessible through an opening left in the wall and covered with the flush chromium plated brass plate or access panel securely fastened in place.

D. Where test tees are installed at the base of the stack, or on the stack, they may be used as a cleanout.

E. Brass cleanouts shall be solid nut construction.

F. Provide the Owner with six wrenches for removing flush cleanout plugs.

3.6 INTERIOR WATER PIPING

A. Test all water piping.

B. Pipe used in piping assembly must be clean of dirt and obstructions and shall have ends square and reamed before butting into the fittings.

C. Cut the tube to the required length with hacksaw or tube cutter designed for copper work.

D. Remove burrs from the inside and outside of the cut edge and clean the end of the tube with steel wool or sand cloth until all discoloration is removed and metal is smooth and bright.

E. Oxides will be removed by sand cloth, brush, etc.

F. Removal of oxides or discoloration of pipe and fittings by acids or self-cleaning flux is forbidden.

G. Apply a thin, uniform and complete coating of reliable brand of soldering flux meeting the ASME Standard BWS/A5.8, lead free to the cleaned surfaces of the tube and fittings.

H. When joints are soldered, remove excess solder with a cloth or brush leaving a fillet of solder in the chamber at the end of the fitting.

I. All piping must be true and plumb and with proper pitch for draining after soldering – **No Dead End Piping.**

J. All lines of water piping shall be protected from water hammer by air chambers and/or shock absorbers. Where air chambers are used, extend branch piping upward at least 20 times the diameter of the pipe. To install air chambers, pipe dropped into pipe spaces shall be carried full size as branches to fixtures with full size air chambers. Where shock absorbers (or shocks) are used, they shall be as manufactured by Josam Mfg. Co., JR Smith, or Zurn Mfg. Co., shall conform to the Plumbing and Drainage Institute published requirements and shall be made accessible through access panels.

L. Furnish and install all valves required to isolate sections of the piping system extending into areas scheduled for construction at a later date. Provide any and all draw-off valves which may be required to properly chlorinate the system in sections as required by the phasing of the Building. Identify future isolation and phasing valves as such with valve tags and include same on charts and as-built drawings.

3.7 DISINFECTION OF ALL WATER SYSTEMS

A. General

1. All water piping systems shall be thoroughly disinfected with a solution containing not less than 50 parts per million of available chlorine by this Plumbing Subcontractor. The chlorinating material shall be either liquid chlorine or sodium hypo chlorite solution.

2. This work is to be supervised by the Owner's representative and performed by an Owner approved chemical testing laboratory and results sent to the Architect/Engineer or his representative for verification. All costs shall be borne by this Plumbing Subcontractor.

3. The testing laboratory shall submit a summary of the test procedure to the Owner for approval prior to any work being performed. All work to be in accordance with the Owner's requirements. This Plumbing Subcontractor shall provide any and all valves, pipe and connections required to disinfect the water supply system totally or in part as required. Provide isolating valves and draw-off valves for proper containment, phasing and flushing.

B. Procedure

1. The water systems shall be tested and thoroughly flushed prior to chlorination.

2. The chlorine shall be introduced at the point of the building water service for interior piping. The disinfection solution shall be allowed to remain in the system for a period of 24 hours, during which period all valves and faucets shall be opened and closed several times with the chlorine drawn to all points in the system. After disinfection, the solution shall be flushed from the system with potable water until the residual chlorine content is not greater than 0.2 parts per million. Prior to any further testing procedures, the Engineer and the Owner shall review all draw-off valve locations and chlorine introduction locations.

3. The Plumbing Subcontractor is to allow ample time for the chlorination of the water systems and is to plan the chlorination just prior to occupancy if possible. If the system is to sit dormant for any extended period of time prior to occupancy, the contractor is to flow water to all points in the building to completely flush the systems prior to occupancy. A full three days notice will be given the Owner and Engineer prior to the start of disinfection.

C. Tests

1. The Owner's representative shall select two locations on each floor of each building for a chlorine concentration test. The Owner's representative shall select three locations on each floor for a chlorine residual, a coliform bacteria and total plate count bacteria tests. The laboratory report shall include sample locations, chlorine concentration, chlorine residual, coliform bacteria count and, after flushing, total plate count bacteria tests.

2. Acceptable limits for total plate count shall be 300 per 100 ml sample. Acceptable levels of chlorine residual shall be .2 PPM.

3. If these parameters are not met, continued flushing of the water systems shall be required until they are met.

4. Full Owner acceptance of the water systems shall not be given until these parameters are met, documented and submitted by the Testing Laboratory selected

3.8 PLUMBING CONNECTED EQUIPMENT

A. Furnish and install waste and vents, traps, protected cold water, protected hot water, domestic hot and cold water piping, and treated water piping as required including pipe stands and trim and all final connections to plumbing connected equipment furnished by others. Roughing for this equipment shall be as indicated on the drawings.

B. Furnish and install shutoff valves at each piece of equipment. Obtain exact roughing in dimensions from manufacturers of all service locations before connecting to or roughing for equipment.

C. Furnish and install backflow preventers, pressure reducing valves and vacuum breakers as required.

D. Sinks and equipment connected to by this Contractor but furnished and set under another section of the Specifications shall be identified on the drawings by SK (sink), etc., as opposed to a plumbing contractor furnished and installed fixtures indicated on the drawings by a "P" number. Coordinate casework and sink units with Section 11200.

3.9 NATURAL GAS SYSTEMS

A. Connect to new service where indicated with an approved shutoff valve and extend to the required points throughout the buildings. Obtain permits and defray all costs incidental to the interior gas piping. Furnish and install all piping, stop valves and connections to all equipment and outlets requiring gas within the building.

B. A suitable drip or condensate pocket shall be installed at bottom of risers.

C. Gas piping and safety devices shall conform to the requirements of the NFPA Standard No. 54 and shall be subject to inspection and approval of the State Gas Regulatory Board.

E. Special Note: Furnish and install aluminum check valves in all gas pipes that enter rooms where compressed air is also installed or when both compressed air and gas piping connect to the same piece of equipment. This is required in all laboratories and areas where gas and air are present together.

F. Provide a gas cock valve at each branch runout from main or riser serving gas outlets.

G. All piping shall be securely fastened separately hung and shall not support any other weight or piping. Piping dropping in concrete block walls shall be factory wrapped for corrosion protection.

H. Gas valves or cocks shall not be concealed and shall be readily accessible for inspection and repair. All welded piping shall conform to the latest requirements of the National Fuel Gas Code.

END OF SECTION

SECTION 15400 – PLUMBING

INDEX

SECTION 15480 – DENTAL/MEDICAL GAS AND VACUUM SYSTEMS

PART ONE – GENERAL

1.1 REFERENCES

A. All of the Contract Documents, including General and any Supplementary Conditions and Division 1 – General Requirements, apply to the work of this section.

B. Examine all Drawings and all other Sections of the specifications for requirements therein affecting the work of this trade.

1.2 DEFINITIONS

A. Words in the singular shall also mean and include the plural, wherever the context so indicates and words in the plural shall mean the singular, wherever the context so indicates.

B. Wherever the terms "shown on drawings" are used in the specifications, they shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.

C. Wherever the term "provide" is used in the specifications it will mean "furnish" and "install", "connect", "apply", "erect", "construct", or similar terms, unless otherwise indicated in the specifications.

D. Wherever the term "material" is used in the specifications it will mean any "product", "equipment", "device", "assembly", or "item" required under the Contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.

E. The terms "approved", or "approval" shall mean the written approval of the Architect.

F. The term "specification" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, including all drawings.

G. The terms "directed", "required", "permitted", "ordered", "designated", "prescribed" and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect. The terms "approved", "acceptable", "satisfactory" and similar words shall mean approved by, acceptable or satisfactory to the Architect. The terms "necessary", "responsible", "proper", "correct" and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.

H. "Piping" includes in addition to pipe or mains, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

I. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.

J. "Exposed" means not installed underground or "concealed" as defined above.

K. "Plumbing Subcontractor" refers to the Subcontractor or his Subcontractors responsible for furnishing and installation of all work indicated in the medical gas specifications and as shown on the designated drawings.

1.3 SCOPE

A. Perform work and provide material and equipment as shown on the Designated Drawings and as specified or indicated in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide a complete and fully functional installation.

B. Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

C. Give notices, file plans, obtain permits and licenses, pay fees and obtain necessary approvals from all Authorities Have Jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings and Addenda all of which are part of these Contract Documents.

D. The Scope of the Work consists of the installation of all materials to be furnished under this Section, including all associated work required, and without limiting the generality thereof, to include:

All work in Section 15400 – Plumbing
Dental vacuum piping system
Dental Air piping systems
Industrial Air piping system
Oxygen & Nitrous Oxide piping system
Medical gas alarms
Medical gas connections
Installation testing – medical gas system
Certification testing – medical gas system
Valves
Core drilling
Furnishing of access panels
Record drawings
Hangers, sleeves and appurtenances
Installation of firestopping & smokeproofing
Staging, scaffolding and rigging
Industrial Air equipment
Dental Air equipment
Vibration isolation
Dental vacuum equipment
Medical gas connections to outlets
Seismic bracing
Building automation system

Control/interlocking wiring
Connection to owner furnished equipment
Seismic restraints

E. The following work is not included in this Section and is to be performed under other Sections:

1. Cutting and patching.
2. Temporary water, facilities and controls.
3. Housekeeping pads, in concrete:
4. Flashing of all pipe penetrations.
5. Finish painting.
6. Plumbing work.
7. Heating, ventilating and air conditioning work.
8. Electrical power wiring.
9. Installation of access panels furnished under this Section shall be by the Trades as designated by the Construction Manager.
10. Temporary light, power, water, heat, and sanitary facilities for use during construction and testing.
11. Sprinkler system.
12. Fire alarm system and controls.
13. Furnishing or fire and smokeproofing materials.

1.4 CODES, STANDARDS AND REFERENCES

A. All materials and workmanship shall comply with all latest editions of applicable Codes, Local and State Requirements and requirements of all Authorities Having Jurisdiction, and these specifications.

B. In case of difference between any Regulations and the Contract Documents, the Medical Gas Subcontractor shall promptly notify the Architect in writing of any such difference.

C. In case of conflict between the Contract Documents and the requirements of any Code or requirements of any Authorities Having Jurisdiction, the most stringent requirements of the aforementioned shall govern. Plumbing Subcontractor shall promptly notify the Architect in writing of any such occurrence.

D. Should the Plumbing Subcontractor perform any work that does not comply with the requirements of the specifications and applicable Codes, he shall bear all costs arising in correcting the deficiencies to the satisfaction of the Architect.

E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations and the applicable requirements of the following accepted Codes and Standards, without limiting the number, as follows:

F. Applicable Codes

1. Local and state building, plumbing, mechanical, electrical, fire and health department codes.
2. National Fire Protection Association (NFPA)
3. Occupational Safety and Health Act (OSHA)
4. Underwriters' Laboratories (UL)
5. International Building Codes (IBC) 2006
6. NFPA-99 (2010)

G. In these specifications, references made to Code are intended to indicate the accepted volume or publication of the Standard or applicable Code. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:

1. ANSI American National Standards Institute
2. ASME American Society of Mechanical Engineers
3. ASTM American Society of Testing Materials
4. AWS American Welding Society
5. CS Commercial Standards, U.S. Department of Commerce
6. MSS Manufacturers Standardization Society of the Valve and Fittings Industry
7. NEMA National Electrical Manufacturers Association
8. UL Underwriters' Laboratories, Inc.

H. Specific reference is made to the following NFPA codes which shall govern provision of work as specified and as required by codes and authorities.

1. No. 72 National Fire Alarm Code
2. No. 101 Life Safety Code
3. No. 99 Health Care Facilities

I. The Plumbing Subcontractor for the work shall give all necessary notices, obtain and pay for all permits, pay all taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. The Plumbing Subcontractor shall obtain all required Certificates of Inspection for his work and deliver same to the Architect before request for acceptance of his portion of work is made and before final payment.

1.5 GUARANTEE

A. Attention is directed to provisions of the General Conditions and Supplementary General Conditions regarding guarantees and warranties for work under this Contract.

B. Manufacturers shall provide their standard guarantees for work under this Contract. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and

Construction Manager may have by Law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the Medical Gas systems, as determined by the Architect and shall remain in effect for a period of one (1) year thereafter.

C. All materials, items of equipment and workmanship furnished under each Section shall carry the standard warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the Plumbing Subcontractor including all other damage done to areas, materials and other systems resulting from this failure.

D. The Plumbing Subcontractor shall guarantee that all elements of the systems provided under his Contract, are sufficient to meet the specified performance requirements as set forth herein or as indicated.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the Plumbing Subcontractor within one (1) week at no cost to the Owner.

F. The Plumbing Subcontractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

G. Provide 24 hour service beginning on the date the project is first occupied, whether or not fully occupied, and lasting until the termination of the guarantee period. Service shall be at not cost to the Owner. Submit name and a phone number that will be answered on a 24 hour basis each day of the week, for the duration of the service.

H. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's satisfaction, advise Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Architect will determine course of action.

1.6 THE SUBCONTRACTOR

A. The Plumbing Subcontractor shall study all Contract Documents included under this Contract to determine exactly the extent of work provided under this Section, and in installing new equipment and systems and coordinating the work with the other Trades.

B. The Plumbing Subcontractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications.

C. The Plumbing Subcontractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed directly or indirectly by the Medical Gas Subcontractor shall perform their work according to all the conditions as set forth in these specifications.

D. The Plumbing Subcontractor shall furnish all materials and do all work in accordance with these specifications and any supplementary documents provided by the Architect. The work shall include every item shown on the drawings and/or required by the specifications as interpreted by the

Architect. All work and materials furnished and installed shall be new and of the best quality and workmanship. The Plumbing Subcontractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed.

1.7 COORDINATION OF WORK

A. The Plumbing Subcontractor shall compare his drawings and specifications with those of other Trades and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the medical gas work. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, Plumbing Subcontractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the Medical Gas/Dental work caused by the Plumbing Subcontractor's neglect, shall be made by him at his own expense, to the Architect's satisfaction.

B. Locations of pipes and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. The Plumbing Subcontractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component.

C. Lines which pitch shall have the right-of-way over those which do not pitch. For example, waste piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.

D. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. All work shall be installed in a way to permit removal (without damage to other parts) of coils, filters, control appurtenances, fan shafts and wheels, filters, belt guards, sheaves and drives and all other system components provided under this Contract requiring periodic replacement or maintenance. All piping shall be arranged in a manner to clear the openings of swinging overhead access doors as well as ceiling tiles.

F. The Contract Drawings are diagrammatic only intending to show general runs and locations of piping, equipment, and specialties and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom. All changes required due to job conditions must be approved by the Architect prior to commencement of work.

G. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, alarm points, etc., such conflicts shall be reported to the Architect prior to signing of the Contract. If such action is not taken, the Plumbing Subcontractor shall furnish such items as part of his work as necessary, for complete and operable systems and equipment, as determined by the Architect.

H. Where drawing details, plans and/or specification requirements are in conflict and where pipe sizes of same pipe run is shown to be different between plans and/or between plans and sections or details,

the most stringent requirement will be included in the Contract. Medical Gas/Dental systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.

I. Final location of all alarm panels, alarms, gas outlets shall be coordinated with the Architectural plans and/or other Architectural details, as applicable. Offsets of piping, elbows, etc., shall be provided as required to comply with the architectural plans. Obtain approval of locations of all devices from Architect in the field.

J. Included as part of coordination the Plumbing Contractor shall maintain service and maintenance access around all medical gas equipment.

1.8 COORDINATION DRAWINGS

A. Before materials are purchased, fabricated or work is begun, each Subcontractor shall prepare coordination drawings for all floors/areas, including buried systems/services (all-Trade-composite at 3/8 inch scale), showing the size and location of his equipment and lines, in the manner described herein under General Requirements - Section 01040.

B. Coordination drawings are for the architect’s use during construction and shall not be construed as shop drawings or as replacing and shop drawings. The coordination drawings, when corrected for actual “as-built” conditions, will be reviewed by the Architect, corrected and become the Record Drawings to be submitted to the Owner for his use.

C. The cost of producing and reproducing the drawings will be included under the Contract of each Trade, including the cost or preparation of the Architectural building outlines. The HVAC Contractor shall take the lead to produce the Architectural backgrounds, show all ductwork, piping, etc., and circulate the drawings to any of his Subcontractors and the other Trades (Plumbing, Fire Protection, Electrical), so that they can indicate all their work as directed by the Architect as required, to result in a fully coordinated installation.

D. In addition to the regular coordination drawing review, the medical gas work will also be reviewed by the Architect/Engineer to ensure that the system and equipment arrangements are suitable to provide maintenance access and service as follows:

1. Valves and instrumentation should be grouped where possible and positioned in accessible locations.

E. Prepare a complete set of computer based AutoCad 2010 drawings at scale not less than 3/8" equals 1'-0", showing basic layout for the structure and other information as needed for preparation of Coordination Drawings. The drawings shall indicate the layout of all specialty tradework as indicated herein and shall be designated as Coordination Drawings. The Contractors can purchase a copy of the floor plans on disk from the engineer to assist in the preparation of Coordination Drawings. The

Contractor shall provide a minimum of two (2) weeks notice to the engineer for the preparation of the disk. A signed liability release form will be required from the Contractor prior to the release of the disk from the engineer.

F. Highlight all fire rated partitions on the Coordination Drawings for appropriate coordination.

G. The main paths for the installation of equipment from mechanical and electrical rooms shall be clearly indicated on the Coordination Drawings.

H. Each of the specialty trades shall add its work to the base drawings with appropriate elevations and grid dimensions. Specialty trade information shall be required for fan rooms and mechanical rooms, horizontal exits from duct shafts, crossovers and for spaces in the above ceilings where congestion of work may occur such as corridors and, where required, entire floors. Drawings shall indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions and other services. Indicate elevations relative to finish floor for bottom of ductwork and piping and conduit 2" greater in diameter.

1. Specialty Trade shall include:

a. Plumbing system.
b. HVAC piping and equipment
c. Electrical
d. Sheet Metal Work
e. Sprinkler System
f. ATC system
g. Medical Gas/Dental system

I. Upon completing their portion of the Coordination Drawings, each specialty trade shall sign, date and return Coordination Drawings to the Contractor.

J. Where conflicts occur with placement of materials of various trades, the Construction Manager shall be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialized and dated by the affected specialty trade subcontractor. The Construction Manager shall then final date and sign each drawing.

K. Fabrication shall not start until Coordinate Drawings have been distributed to all parties as indicated herein.

L. Format: Coordination Drawings (plans only) shall be done using CAD in AutoCAD, 2010 in either IBM or Mac Format, disks shall be given to the architect for future transfer to Owner. Coordination Drawings will be used as base for as-built drawings.

M. Distribution of Coordination Drawings:

1. The General Contractor shall provide one print of each Coordination Drawing to:

a. Each specialty trade Subcontractor.
b. Owner
c. Construction Manager
d. Architect (for record purposes).

N. After distribution:

1. The method used to resolve interferences not previously identified shall be as in paragraph F. above. Distribute revised Coordination Drawings to all parties listed above.

O. Coordination Drawings include but are not necessarily limited to:

1. Structure
2. Partition/room layout, including indication of smoke and fire resistance rated partitions.
3. Ceiling layout and heights
4. Light fixtures.
5. Access Panels
6. Sheet metal, heating coils, boxes, grilles, diffusers, etc.
7. All heating piping and valves.
8. Smoke and fire dampers.
9. Soil, waste and vent piping.
10. Major water and gases.
11. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit. Motor control centers, starters and disconnects.
12. Sprinkler piping and heads.
13. All equipment, including items in the Contract as well as O.F.C.I. and O.F.I. items.
14. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur indicates areas in which the required access area may be greater than the suspected grid systems.
15. Medical gas and vacuum.
16. Dental Vacuum & Dental Air Compressor Systems

1.9 GIVING INFORMATION

A. The Plumbing Subcontractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the Architect and other Subcontractors sufficiently in advance of the work so that all openings may be built in advance.

1.10 EQUIPMENT AND MATERIALS

A. Equipment and materials shall be delivered to the site and stored in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls, switches, etc., shall be stored in dry, heated spaces.

B. The Plumbing Subcontractor shall have his equipment tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned, polished thoroughly and turned over the Owner in a condition satisfactory to the Architect. Damage or defects developing before acceptance of the work shall be made good at the Medical Gas Subcontractor's expense.

C. The Plumbing Subcontractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.

D. The manufacturers listed within this specification have been preselected for use on this project. No submittal will be accepted from a manufacturer other than specified. Should the Plumbing Subcontractor wish to propose a substitution during the bid period, such request shall be made in writing to the Architect, no less than seven (7) working days, prior to bid date. If substitutions are deemed acceptable, such items shall be issued on an Addendum, prior to bid due date. The above requirement is mandatory.

E. Manufacturers' directions shall be followed completely in the delivery, storage, protection and installation of any equipment. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's written instructions before proceeding with the work. Should the Medical Gas Subcontractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.

F. The Plumbing Subcontractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.

G. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of the Plumbing Subcontractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, the Plumbing Subcontractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Plumbing Subcontractor shall make all necessary changes in all affected related work provided under other Sections including location of roughing in connections by other Trades, electrical requirements, piping, supports, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.

H. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. Equipment and materials shall be products which will meet with the acceptance of the Authorities having jurisdiction over the work and as specified hereinbefore. Where such acceptance is contingent upon having the products listed or labeled by FM, UL or other testing

laboratories, the products shall be so listed or labeled. Where no specific indication as to the type or quality of material or equipment is indicated, a first class standard article shall be provided.

I. All equipment of one type (such as valves, outlets, switches, etc.), shall be the product of one manufacturer, unless otherwise specified.

1.11 CUTTING AND PATCHING

A. All concrete and masonry equipment bases and pads, curbs, chases, pockets and openings required for the proper installation of the work under this Contract will be provided by the Construction Manager, using information, as shown on the drawings and/or as required and furnished by the Plumbing Subcontractor. At a minimum, concrete bases (housekeeping) pads shall be 4 inches high and extending 3 inches on all sides beyond equipment (for all base mounted equipment).

B. In addition to the requirements outlined herein for cutting and patching, the Medical Gas Subcontractor shall be responsible for core drilling all holes required for work under his Contract and with the written approval of the Architect.

C. In no case shall the Plumbing Subcontractor cut into any structural elements without the written approval of the Architect.

1.12 USE OF PREMISES

A. The Medical Gas Subcontractor shall confine all of his apparatus and storage of materials and construction to the work area or limits as directed by the Architect and he shall not encumber the premises with his materials.

B. In storing materials within areas (structure or ground), or when used as a shop, the Plumbing Subcontractor shall consult with the Construction Manager and shall restrict his storage to space designated for such purposes. The Plumbing Subcontractor will be held responsible for repairs, loss, patching or cleaning arising from any unauthorized use of premises.

C. Notwithstanding any approvals or instructions which must be obtained by the Fire Protection Subcontractor from the Architect in connection with use of premises, the responsibility for the safe working conditions at the site shall remain the Plumbing Subcontractor's and the Architect or Owner shall not be deemed to have any responsibility or liability in connection therewith.

1.13 PROTECTION

A. All materials such as valves, fittings, piping etc., shall be properly protected and all piping openings shall be temporarily closed by the Plumbing Subcontractor installing same, so to prevent obstruction and damage. To protect the equipment, temporary covers of substantial nature shall be provided to

assure that items such as alarm panels, outlets, valves, etc., are not damaged. The Plumbing Subcontractor shall take precautions to protect his materials from damage and theft.
Plumbing Subcontractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or systems provided under his Contract.

1.14 DAMAGE TO OTHER WORK, CORRECTION OF WORK AND EXTRA WORK

A. The Plumbing Subcontractor shall be held responsible and shall pay for all damages caused by his work to the building structure, equipment, piping, duct systems, etc., and all work and finishes installed under this Contract in the building. Repair of such damage shall be done as herein before specified, at the expense of the Plumbing Subcontractor and to the Architect's satisfaction.

B. The Plumbing Subcontractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after completion of work and whether or not fabricated, installed or completed. The Plumbing Subcontractor shall bear all costs of correcting such rejected work.

C. No claim for extra work will be allowed unless it is authorized by the Architect in writing before commencement of the extra said work.

1.15 PIPE SLEEVES, PLATES AND ESCUTCHEONS, FIRE STOPPING AND SMOKEPROOFING

A. Where pipes pass through all walls or floors, the Plumbing Subcontractor shall provide and set individual sleeves for each pipe and all other work under his charge, as necessary for passage of all pipes. Sleeves shall be of sufficient size to provide 1/2 inch air space around the pipe passing through it. All openings shall be sealed, smokeproofed and made tight. The Plumbing Subcontractor shall be responsible for the exact location of sleeves provided under this Contract and shall coordinate all requirements for piping sleeves.

B. The Plumbing Subcontractor, for work under his charge, shall determine the diameter of each individual wall opening or sleeve before ordering, fabrication or installation.

C. Sleeves and inserts shall not be used in any portions of the building, where their use would impair the strength or construction features of the building. Elimination of sleeves must be approved by the Architect.

D. Provide chrome-plated brass escutcheons with set screw for exposed piping, in all areas. In mechanical rooms use plain brass or cast iron escutcheons suitable for painting. All escutcheons shall be sized to fit the bare pipe or insulation in a snug and neat manner. They shall be of sufficient size to

cover sleeved openings for the pipes and of sufficient depth to cover sleeves projecting above floors. Escutcheons shall be as manufactured by Beaton and Caldwell, Dearborn Brass or Grinnell.

E. Exterior wall sleeve through masonry walls shall be made water tight by the use of Mechanical Link Seal.

F. Pipe sleeves shall be required on all pipes passing through all walls and shall be made of Schedule 40 pipe, 16 gauge galvanized steel or 16 gauge steel as follows:

1. Sleeves on pipes passing through masonry or concrete construction shall be Schedule 40 pipe.

2. Sleeves passing through masonry partitions shall be 16 gauge steel unless required otherwise by item 1. above.3. Sleeves on pipes passing through drywall construction shall be 16 gauge galvanized steel.

3. Sleeves on pipes passing through fire rated drywall partitions shall be 16 gauge steel.

G. Pipe sleeves shall be set as follows:

1. Set sleeves 1 inch above finish floor (6 inches at penthouses and mechanical rooms) and flush on each side of walls, except sleeves through floor occurring in walls and partitions shall terminate flush with finish floor.

2. Sleeves shall be set securely in place before concrete is poured.

H. The Plumbing Subcontractor shall firestop or smokestop the space between the sleeves provided under his Contract and pipes as applicable, as required by General Conditions.

1.16 WATERPROOFING, FLASHING AND COUNTERFLASHING

A. Unless specifically indicated otherwise, the Plumbing Subcontractor shall provide all counterflashing and waterproofing of all piping, and equipment provided by him, which pierce roofs, walls and other weather barrier surfaces. All work under this paragraph shall be coordinated with the Construction Manager.

B. All work shall be performed in a workmanlike manner to assure weatherproof installation. Any leaks developed due to this Subcontractor's work shall be repaired at his expense, to the Architect's satisfaction.

C. Pipes passing through slabs shall have the sleeve extended above floors as hereinbefore specified to retain any water and the space between the pipe and sleeve caulked with lead wool. The top shall be

sealed with lead and the bottom shall be sealed with monolastic caulking compound. The space between the outside of the sleeve and the floor slab shall be caulked watertight sufficiently to hold 2 inches of standing water.

D. All flashing required for piping penetrations shall be provided by the Construction Manager.

1.17 MISCELLANEOUS IRON AND STEEL

A. The Plumbing Subcontractor shall provide all steel supports and hangers as shown on the drawings and/or required to support all Plumbing equipment, systems and materials provided under this Contract.

B. All work shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets and framework shall be properly sized and strongly constructed.

C. Measurements shall be taken on the job and worked out to suit adjoining and connecting work. Members shall be straight, true and accurately fitted.

D. Drilling, cutting and fitting shall be done as required to properly install the work and accommodate the work of other Trades as directed by them.

E. Members shall be generally welded except that bolting may be used for field assembly where welding would be impractical.

F. All shop and field fabricated iron and steel work shall be cleaned and dried and given a coat of rust inhibiting paint on all surfaces and in all openings and crevices.

1.18 ELECTRICAL WORK, MOTORS, MOTOR CONTROLLERS

A. All electrical apparatus and controls furnished as a part of the Medical Gas work shall conform to applicable requirements under Electrical Section.

B. The Plumbing Subcontractor shall provide the Electrical Subcontractor with all electrical requirements within thirty (30) days from date of Contract to allow proper coordination of Trades by the Construction Manager.

C. The Plumbing Subcontractor shall verify with the Electrical Subcontractor available electrical characteristics before ordering any equipment or motors.

1.19 IDENTIFICATION OF MATERIALS

A. All equipment used in the Plumbing systems shall have a permanently attached nameplate identifying the manufacturer, service, size, serial number or model number, etc. The nameplates shall be kept clean and readable at all times.

B. Each item of equipment not provided with a manufacturer's nameplate, shall be identified by a permanently attached nameplate made of black surface, white core laminated bakelite with 1 inch high indented letters. Nameplates shall be minimum of 5 inches long by 3 inches wide and bear the equipment name as designated in the equipment schedules or the specifications. Nameplates shall be as fabricated by Seton Nameplate Company, Atlantic Engraving Company, W.H. Brady Company or approved equal.

C. A legend showing the service and an arrow indicating the direction of flow shall be applied on each pipe installed by the Plumbing Subcontractor.

D. The piping shall be identified in the following locations and where directed by the Architect.

1. Pipe mains and branches every 15 feet.
2. At each valve.
3. Each wall penetration (both sides).
4. Each riser including branch risers from mains.
5. At each piece of equipment.
6. As required by NFPA-99 (2010)

E. The identification of piping shall be coordinated with the Owner. Obtain approval of Architect prior to installation. The letter size and background color shall conform to the ANSI Scheme for the Identification of Piping Systems (ANSI 13 latest amendment) and the Hospital Standards.

F. Submit color code samples of each I.D. system.

1.20 VALVE TAGS, NAMEPLATES AND CHARTS

A. All valves on pipes of every description installed by the Plumbing Subcontractor, shall be provided with neat circular brass valve tags of at least 1 1/2 inches in diameter, attached with brass hook to each valve stem or handle. Tags shall have stamped on, in letters as large as practical, the number of the valve and the service. The numbers of each service shall be consecutive. Obtain approval of Architect prior to installation.

B. All numbers utilized shall correspond to numbers indicated for valves on the Record Drawings and on two (2) printed detailed lists. These printed lists shall state the numbers and locations of each valve and the equipment or system which it controls and other necessary information such as requiring the opening or closing of another valve or valves when any one valve is to be opened and closed.

C. These printed lists shall be prepared in form to meet approval of the Architect and shall be framed under glass.

D. The Plumbing Subcontractor shall provide for his work all valve charts including Plumbing Subcontractor's name and telephone number; date of chart; name and telephone number of Architectural Firm and Consulting Engineering Firm.

1.21 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

A. Refer to Section 01800 of Division 1 - General requirements for the requirements of this Section.

1.22 MANUFACTURER'S REPRESENTATIVE AND START-UP OF SYSTEMS

A. The Plumbing Subcontractor shall provide, at appropriate time or as directed by the Architect, the onsite services of a competent factory trained Engineer or authorized representative of particular manufacturer of equipment to instruct the Owner, inspect, adjust, test and place in proper operating condition any item provided by him, as applicable.

B. The Plumbing Subcontractor, as applicable, shall commission and set in operating condition all major equipment and systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. In no case will major systems and equipment be commissioned by any of the Subcontractor's forces alone, without the assistance or presence of the equipment manufacturers.

C. A written report shall be issued by the particular equipment manufacturer and the Plumbing Subcontractor summarizing the results of the commissioning and performance of each system for the Architect's record. No additional compensation will be allowed for any Subcontractor for such services.

1.23 ELECTRICAL ROOM REQUIREMENTS

A. The Plumbing Subcontractor shall not install any piping, or equipment in or through electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms, unless piping, or equipment is intended to serve these rooms. Additionally, no piping will be installed above electric panels or within the limits of any Code requirements. If the Plumbing Subcontractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.

1.24 RECORD DRAWINGS

A. The Plumbing Subcontractor shall maintain current at the site a set of his drawings on which he shall accurately show the actual installation of all work provided under his Contract indicating any variation from the Contract Drawings, in accordance with the General Conditions and Supplementary General Conditions. Changes whether resulting from formal change orders or other instructions issued by the architect shall be recorded. Include changes in sizes, location and dimensions of piping, equipment, etc.

B. Utilizing the coordination drawings described herein before, the Plumbing Subcontractor shall modify/correct/edit the Medical Gas/Dental work on the above CAD coordination drawings, to obtain a “CAD” set of Record Drawings. Provide (2) blackline prints and (2) copies of record drawings CAD files.

C. A marked-up and colored-up set of prints on-site will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner’s representatives and they shall be corrected if found either inaccurate or incomplete. This procedure is mandatory.

D. Coordination drawings are for the Contractor's, Architect's, and Owner's use during construction and shall not be construed as replacing any shop drawings. The cad coordination drawings, when corrected for actual "as-built" conditions, will be reviewed by the Architect, corrected and will be used to formulate the Record Drawings to be submitted to the Owner for his use.

E. The Plumbing Subcontractor shall submit a set of CAD files on disc marked "AS-BUILTS". All costs associated with the production and reproduction of the CAD files shall be included under the Medical Gas bid for work under the fire protection contracts.

1.25 HOISTING EQUIPMENT AND MACHINERY

A. Refer to Section 01500 of Division 1 - General Requirements for the requirements of this Section.

1.26 STAGING

A. Refer to Section 01500 of Division 1 - General Requirements for the requirements of this Section.

1.27 SUBMITTALS

A. Shop drawing submittals shall be prepared and submitted as described herein and in accordance with Section 01330 - Division 1 - General Requirements and as modified and noted hereinafter.

B. Disposition of shop drawings shall not relieve the Medical Gas Subcontractor from the responsibility for deviations from drawings or specifications, unless he has submitted in writing a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Architect, nor shall such disposition of shop drawings relieve the Plumbing Subcontractor from responsibility for errors in shop drawings or schedules.

C. Submittal Procedures and Format

1. Review submittal packages for compliance with Contract Documents and then submit to Architect for review.
2. Verify quantities and type of medium to be submitted as outlined in Section 01330.
3. Each Shop Drawing shall indicate in title block, and each Product Data package shall indicate on cover sheet, the following information:
4. Title.
5. Name and location of project.
6. Names of Architect, Engineer, Contractor and Subcontractor(s).
7. Names of manufacturer, supplier, vendor, etc.
8. Date of submittal.
9. Whether original submittal or resubmitted.
10. Verify scale and type of drawings required.
11. Shop Drawings showing layouts of systems shall contain sufficient plans, elevations, sections, details and schematics to describe work clearly. They shall be minimum 1/8" = 1'0" scale unless specified otherwise. Provide larger scale details as necessary.

12. All firewalls and smoke partitions must be highlighted on the drawings for appropriate coordination.
13. Shop drawings showing manufacturer's product data shall contain detailed dimensional drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data, alone, is not acceptable), electrical requirements and wiring diagrams. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.

D. Shop drawings shall include but shall not be limited to the following:

1. Medical Gas/Dental work layout, including location and sizes of piping, outlets, equipment, connections, drains, test stations, alarm panels, and all other accessories as required by NFPA 99 (2010).

2. Equipment Cuts For:

a. Alarm panels.
b. Medical Gas outlets.
c. Equipment.
d. Valves, gauges, drains, piping.
e. Hangers, supports.
f. Pressure switches, pressure sensors.
g. Access panels.

1.28 SITE VISIT

A. Before commencing any work under this section, verify all governing dimensions, elevations and locations at the building and examine all adjoining work on which this work is in any way dependent for its perfect efficiency according to the intent of these specifications. Visit and investigate all spaces and conditions to become familiar with installation and all requirements prior to bidding.

B. Each bidder shall visit the site and inspect all conditions affecting any aspect of the work. Failure to do so and misinterpretation of the plans and specifications resulting therefrom shall be entirely the responsibility of the bidder.

1.29 CORE DRILLING

A. This subcontractor shall perform all core drilling required for the proper installation of the Medical Gas system. Locate all required openings and prior to coring coordinate the opening with the General Contractor . Thoroughly investigate the existing conditions in the vicinity of the required opening prior to cutting. Care must be taken so as to not to disturb the existing hospital systems. Locate all other openings required for the Construction Manager. All cored openings are to be by Plumbing Contractor and all other openings are by the General Contractor. Patching of existing walls and openings shall be preformed by the respective trade responsible for the finish material in which the opening is made. Maximum core diameter is 12”.

B. All core drilling locations must be approved by the Owner.

1.30 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Instruct to the Owner's satisfaction such persons as the Owner designated, in the proper operation and maintenance of all Medical Gas/Dental Vacuum systems and equipment and their parts.

B. Furnish operating and maintenance manuals prior to instructions and forward same to the Architect for transmittal to the Owner.

C. This Contractor shall give detailed instructions for a period of not less than 10 days, straight time, to the responsible personnel designated by the Owner in the operation and maintenance of all systems and equipment furnished under this Contract. A letter with five copies containing the name of the person or persons to whom the instructions were given and the dates of instruction period shall be submitted to the Architect/Engineer. Start-up and testing of all equipment supplied by this Contractor shall be performed by authorized factory representatives supplying equipment. Notification of this work must be given to the Owner.

D. This Contractor shall submit to the Architect/Engineer for approval four sets of operating and instruction manuals, spare parts lists, drawings, manufacturer's bulletins and other pertinent data on all equipment furnished under this Contract. Each set shall be enclosed in a suitable hard cover binder. This information must be submitted to the Owner when systems are approximately 90% complete to allow for proper review and familiaration prior to final instruction.

E. Provide name, address, and telephone numbers of manufacturer's representative and service company for each piece of equipment so that service parts can be readily obtained.

F. Upon completion of instructions this Subcontractor shall provide step by step typed procedures to test and operate each piece of equipment including detailed cross referenced drawings to procedure outlined so that all equipment may be tested, shut down, turned on or bypassed by the Owner's representative.

G. Provide a start up video with step-by-step audio instructions at start up and turnover to Owner.

PART TWO – PRODUCTS

2.0 MEDICAL GAS AND DENTAL AIR AND FITTINGS

A. All pipe and fittings shall be specially cleaned and prepared for medical oxygen service by the manufacturer or by a cleaning service company and received sealed on the job. Each length of tube shall be permanently labeled and delivered plugged and capped. Each fitting shall be individually sealed and marked. The Contractor shall furnish documentation from the manufacturer or cleaning service certifying that all piping materials comply with the requirements of this paragraph. The intent of this paragraph is for all materials to be directly delivered to the construction site from the manufacturer or cleaning service.

B. Medical gas (oxygen & nitrous oxide) piping shall be ASTM B819 Type "L" hard drawn seamless copper tube. Piping shall be stamped as per NFPA-99.

C. Dental vacuum exhausts and manifold relief vents shall be ASTM B88, B280 or B819 Type "L" hard drawn copper tube. Piping shall be stamped as per NFPA-99.

D. Fittings: for copper tubing shall be wrought copper pressure fittings, designed expressly for brazing at temperature greater than 1000°F and comply with ANSI B16.22.

E. Brazing Alloy: for assembling braze-joint fittings shall be Copper-Phosphorous-Silver Brazing (BCuP series) alloy and comply with ANSI/AWS A5.8. Flux shall not be used.

F. Threaded Connections: shall be made with fittings described above and shall be made up with Polythetrafluorethylene (such as Teflon) tape. Brush on sealants shall not be used.

G. Shall be used for Dental Air piping, Dental Air Intake & Industrial Air Piping systems.

H. Dental Vacuum Piping

2.2 MEDICAL GAS AND DENTAL AIR VALVES AND GAUGES

A. All valves and gauges shall be specially cleaned and prepared for medical oxygen service by the manufacturer. Valves and gauges shall be supplied to the job site in individual sealed containers and cleaned for medical oxygen service. The contractor shall furnish documentation certifying that all valves and gauges comply with the requirements of this paragraph.

B. Main, Riser, Isolation and Section Valves

1. ½" through 3" shall be AMICO Series # VV-ISO-G2L-XX, full port (3) piece ball valve with threaded connection, lockable handles, extensions and gauge port on both sides of the valve.

C. Zone Valves (MGCV)

1. Shall be AMICO # Series- shutoff valves and valve boxes with threaded connection, extensions, gauge port and gauge.
2. Refer to drawings for location and sizes of valves and specification info.
3. Refer to drawings for detail showing piping of medical gas and vacuum zone valves.
4. This Subcontractor shall provide required “labeling” of MGCV that satisfies NFPA. Submit sample for approval. Labeling shall indicate rooms or areas controlled by each valve.

D. Gauges

1. Main line pneumatic gauges shall be AMICO # P-500-Guage-K-xxx. Gauge face shall read 0-100 PSI for all pressure gases , vacuum gauge face shall read 0-30" Hg.
2. Provide and install ball valves and medical gas check valves prior to all gauges.

2.3 MEDICAL GAS ALARM SYSTEMS

A. General

1. The medical gas alarm system shall be AMICO-A2M-E-20.
2. The Alarms shall comply with NFPA-99 (2010) ~~and CAN/CSA Z305.1-92 standards and be UL Listed. This equipment shall comply with the limits for a Class A, FCC, digital apparatus pursuant to part 15 of the rules, and with Canadian ICES-003 (Interference-Causing Equipment, Digital Apparatus), Issue 3.~~
3. The Alarm Network is a fully electronic monitoring system. It monitors and displays the status of all piped gas systems by using Master Alarms, Area Alarms, and Local Alarms that monitor the following:

Medical gas supplies; Mainline pressure; Area zone pressure

B. Area Alarms:

1. The Area Alarm shall continuously display the actual pressure of the type of gas being monitored, unless there is an alarm error. In that case, the error code displays.

2. The alarm shall provide separate Normal, High and Low LED indicators on each module: a green LED is used for Normal Conditions and red LED’s are used for High and Low alarm conditions. An audible alarm is mounted on the P.C. Board inside the front panel.

3. During normal operation, the Test Key on each module starts a self-diagnostic routine of the seven segment displays, the LEDs, and the audible alarm.

4. Pressure lines are remotely monitored by gas-specific transducers. The transducers are provided with the Area Alarm, are gas specific and include DISS gas specific demand valve

installed at the factory.

5. Transducers shall transmit a digital signal to their respective gas-specific Area Alarm Modules by using up to 4500' of stranded, 22-gauge, shielded, twisted-pair cable. Transducers shall receive their power from their respective Area Alarm Modules.

6. Transducers shall be housed in a transparent enclosure and have an LED inside the housing used to indicate proper function.

7. Transducers not connected to the appropriate gas-specific Area Alarm Module shall transmit an error message to the Area Alarm Module display.

8. Transducers not performing properly shall transmit an error message to its respective Area Alarm Module display.

9. The alarm shall be configured to the NFPA-99 (2010) standard values at the factory, but are field adjustable for high and low alarm set-points. Pressing the increment/decrement keys displays the pressure set points.

10. The Area Alarm has as an optional network communications board that interfaces with the facility's Ethernet via switch or hub. This allows a user to browse and configure the Area Alarm by using a personal computer that is logged onto the facility's Ethernet. Area alarm can also be configured from face of unit without use of computer. Refer to plans for locations.

11. The Area Alarm Panels to be AMICO

2.4 MEDICAL GAS OUTLETS

A. Medical Gas Outlets shall be AMICO- Series for DISS. Refer to schedule on drawings.

B. Wall Outlets shall be DISS key style for Oxygen and Nitrous Oxide.

C. Each outlet consists of a rough-in assembly and a finish assembly. The rough-in assembly consists of a zinc, die-cast backplate with mounting flanges on all four sides, a ½' raised plaster strike, and a non-removable, positive, pin keying arrangement for each specific gas service. Identification of each gas service is permanently cast into the plate. The rough-in inlet is a 7" long, ½" O.D., type K copper inlet tube, with a label identifying the specific gas by name and color, and a plastic dust cap. 360-degree rotation of the inlet tube allows alignment with system piping for connections.

D. The outlet finish assembly of DISS type outlets consists of a powder-coated light neutral, zinc, die-cast, finish faceplate, a front-body keying disc assembly. The keying disc assembly includes a gas-specific, threaded, DISS-keying system that is color coded and labeled with the name of the gas service. The serviceable barrel assembly includes a plastic piston and brass, primary, check valve that engage and seal when an equipment adapter is removed from the outlet.

E. Finish Assembly faceplates shall be designed to provide 4.5" center to center spacing.

2.5 GAUGES AND SENSORS

A. All gauges, switches, sensors and demand checks manufactured by AMICO shall meet NFPA 99 2010 and be cleaned for oxygen in accordance with NFPA 99 2010 and shall be shipped to contractor in individual poly bags.

B. All gauges, switches and sensors shall be installed with individual shut-off ball valves and medical gas check valves between the device and the system. Alarm sensors installed remote from the piping may be installed with shut-off ball valves and medical gas check valves.

2.6 BUILDING AUTOMATION SYSTEM

A. The building automation system shall be furnished and installed under another section. This subcontractor shall provide dual contact pressure switches, tees, pipe wells, valves and caps to allow the connection from the BAS to the plumbing points required. The following table itemizes the equipment, location and type of device necessary to connect to the building automation system.

SERVICE OR EQUIP	PRESSURE	TEMP	FLOW	CONTROL	LOCATION
Dental Vacuum Pumps Typical for 3 Pumps	X	X		Control Panel	Mech Rm Basement
Master Gas Alarm Panel	X Trouble			Alarm Panel	
Master Gas Alarm Panel	X Trouble			Alarm Panel	Nurses Station
Suite Alarm Panel	X Trouble			Alarm Panel	
Industrial Air Compressor	X Trouble	X		Control Panel	Mech Rm Basement
Dental Air Compressor Typical for (2) Compressors	X Trouble	X		Control Panel	Mech Rm Basement

2.7 SEISMIC BRACING

A. The Plumbing Subcontractor shall provide all necessary design and materials for seismic restraint and protection of piping and devices against damage where subject to earthquakes as required for the entire medical gas and vacuum system within the building. All isolation and seismic devices shall be the product of a single manufacturer. Products of other manufacturers are acceptable provided their systems strictly comply with this section of the specifications. Provide isolation materials and seismic restraints complete and as manufactured by Mason Industries, Tolco or approved equal.

The work under this section shall include the design, furnishing and installation of all restraint devices and systems as may be required for the medical gas and vacuum system including, but not necessarily limited to, the following:

1. All Medical Gas/Dental equipment and devices such as pumps, vacuum, tanks, etc.
2. All Medical Gas system piping as required.
3. Piping penetrations through floors and walls.
4. Sleeves with clearances around the outside, as recommended.
5. Equipment isolation bases.
6. Piping flexible connectors.
7. Seismic restraints for isolated equipment.
8. Seismic restraints for non-isolated equipment.
9. Certification of seismic restraint designs.

B. Submit ten (10) copies of descriptive data for all products and materials, including the following:

1. Catalog cuts and data sheets for the specific isolators, restraints and all other items to be utilized.
2. Details of methods of sleeving, smokeproofing and isolation for pipes penetrating walls and slabs.
3. Specific details of seismic restraints and anchors, including number, size and locations for each piece of equipment.
4. Calculations to support seismic restraint designs.
5. All calculations, details and other submittal materials shall be sealed and signed by a structural or civil engineer registered in the state and qualified to perform seismic design calculations.
6. A seismic design liability insurance certificate that must accompany all submittals.

C. Code and standards requirements shall include, but not be limited to:

1. Applicable BOCA-NBC, MSBC with any additional State or Local requirements.
2. NFPA 99 2010 and other applicable NFPA standards.
3. All State and Local codes.

D. Manufacturers working in this section must provide a seismic design liability insurance certificate and certify their ability to provide engineering and design as required by this section. This certificate shall be submitted to the Architect for review prior to any submittals.

2.8 VIBRATION ISOLATION

A. General Requirements

1. The Plumbing Subcontractor shall provide noise and vibration isolation systems to prevent the transmission of excessive airborne and structureborne sound and feelable vibration to critical and non-critical areas of the building (medical gas equipment sound levels not to exceed NC-35 in critical and non-critical areas). Building vibration levels not to exceed recommendations of American National Standard S3.29 Guide for the Evaluation of Human Exposure to Vibration in Buildings.

2. Equipment vibration velocities in axial, horizontal and vertical directions not to exceed 0.20 inches per second in a one-third octave band centered at the shaft RPM. If bearings are not accessible, vibration limit applies at machine the mounting points.

3. All rotating equipment to be dynamically balanced by equipment manufacturers prior to arrival at the project site. Contractor shall, at no cost to the owner, balance equipment not conforming with rotational balance standard.

B. The work under this Section shall include the furnishing and installation of all equipment, appliances, materials, tools, labor and the performing of all operations necessary for the complete execution of the installation of noise and vibration isolation devices and/or systems as may be specified under the equipment specifications elsewhere contained in this Section, as may be scheduled on the drawings and as specified herein, including but not necessarily limited to the following:

1. All mechanical equipment such as pumps, air compressors, etc., shall be isolated from the building structure by means of noise and vibration isolators.

2. All piping over 1 inch diameter shall be isolated from the building structure by means of noise and vibration isolation hangers.

3. Piping penetrations through floors and walls shall not be rigidly connected to the building structure. Provide sleeves with clearances around the outside, as recommended by the vibration materials manufacturer. All such penetrations shall be smoke and firestopped in an approved manner as hereinbefore specified.
4. Generally, isolation facilities shall be designed to limit equipment room floor or roof loading to a maximum of 50 pounds per square foot and vibration isolators shall be carefully and specifically selected for each piece of equipment.

5. Motor driven equipment which is to be isolated, shall have motor mounted on the isolated equipment or shall have motor, equipment and drive mounted on a common base.

C. The vibration materials manufacturer shall be responsible for the proper selection of all isolation materials, including selection of spring rates to accomplish the specified minimum static deflections for spring and pad type isolators, based on weight distribution and location of equipment.

D. The Plumbing Subcontractor shall furnish to the vibration materials manufacturer the following:

1. A complete approved set of shop drawings of all isolated equipment showing operating weight and weight distribution at support points.

2. Submittal data shall be prepared by the vibration materials manufacturer and shall include drawings showing construction of the isolation devices to be used, including specific selection of isolators for each unit to be isolated and shall further include the complete design of supplementary bases, a tabulation of the design of each isolator showing spring O.D., free operating and solid heights, ratio of horizontal to vertical stiffnesses and other pertinent data as may be required to clearly indicate that the specified mount types and minimum static deflections are provided by the proposed systems submitted.

Installation shall not proceed until the submittal data has been reviewed and released for construction by the Architect.

E. Materials

1. The use of non-permanent materials such as cork, rubber, wood pulp products or thermal type fiberglass will not be acceptable.

2. The isolation materials, unless otherwise specified, shall be the standard products of Mason Industries, Vibration Eliminator Company, Consolidated Kinetics Corporation or Korfund Dynamics Corporation. Provide minimum 4" thick reinforced concrete pads beneath all floor mounted and vibration isolated equipment.

3. Vibration hangers for piping shall contain a steel spring and 0.3 inch deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid, equal to 50% of the rate deflection. Submittals shall include a scale drawing of the hanger showing the 30 degree capability. Hangers shall be Type 30N as manufactured by Mason Industries. Installed on piping in plumbing equipment room and within 50 feet of room.

F. Bolt Compressors and Vacuum Pumps to Inertia Bases

1. Be a steel reinforced concrete slab poured into a welded structural steel channel frame.
2. Be provided with height saving brackets that support base 1" to 2" above the floor or pad.
3. Be a minimum of 1/12th the longer base dimension, but not less than 6", or thickness such that the concrete inertia base weight is no less than the weight supported.
4. Have required mounting bolts to secure machinery supported as needed.
5. Mount inertia bases on sway-restrained steel spring isolators attached to inertia base by means of height-saving brackets. Springs to have minimum installed static deflection of 2".

G. For all pumps located in building, provide flexible stainless steel hose with stainless steel braid and carbon steel fittings at pump inlet and outlet. Sizes 2-1/2 inches and up shall be flanged. Pipe sizes up to 2 inches shall have male nipples. Lengths shall be as follows:

FLANGED		MALE NIPPLES	
2-1/2 x 14	8 x 22	1/2 x 9	1-1/4 x 12
3 x 14	10 x 26	3/4 x 10	1-1/2 x 13
4 x 15	12 x 28	1 x 11	2 x 14
5 x 19	14 x 30		
6 x 20	16 x 32		

H. All pump units less than 5 HP in the basement shall be installed and grouted in place in accordance with the

Standards of the Hydraulic Institute. All pump units less than 5 HP not located in the basement shall be mounted on height-restrained steel spring isolators sized to provide a 1" spade deflection. Attachment of isolators to the sides of pump base will be by height-saving brackets and as per manufacturer's recommendations. All pump units 5 HP and larger shall be grouted to concrete inertia bases in accordance with the standards of the Hydraulic Institute. Inertia bases shall be:

1. Be a steel reinforced concrete slab poured into a welded structural steel channel frame.
2. Be provided with height-saving brackets that support base 1" to 2" above the floor or pad.
3. Be a minimum of 1/12th the longer base dimension, but not less than 6", or thickness such that the concrete inertial base weight is no less than the weight supported.
4. Have required mounting bolts to secure machinery supported as needed.

I. Mount inertia block and pump assemblies on height restrained steel springs sized to provide a 1" spade deflection. Attachment of springs to inertia blocks shall be by means of height-saving brackets mounted to the sides of the inertia blocks. All springs to have minimum installed static deflection of 1".

1. After the installation of the pumps and piping has been fitted and adjusted, the pump manufacturer shall check the motors and pumps for proper alignment, shall check the pump glands for proper tightness and shall check all bearings for proper lubrication before the pumps are first started. When the pumps are started and placed in operation, the medical gas and vacuum subcontractor shall take complete amperage readings on each phase of all pump motors and nameplate current rating.

2. Mechanical vibration at the pump suction and/or discharge flanges shall not exceed 85 acceleration decibels over the frequency range of 20 Hz to 2.5 KHz. The critical frequencies of the fundamental rotational rate and vane shall not exceed 95 acceleration decibels referenced to 1 micro-g. The pump manufacturer shall be capable of furnishing certified sound test curves.

   a. Vibration Isolation

      1) Includes resilient mounts and hangers designed to minimize the transmission of vibration to the building structure. These are composed of steel springs, neoprene elements, or some combination of these.

   b. Equipment Bases

      1) Includes rails, inertia bases, or other steel carrying operating equipment.

   c. Flexible connectors to vibration isolated equipment

      1) Includes all hose, electrical, control, pipe, and duct connections to operating equipment mounted on vibration isolators.

   d. Vibration isolation performance criteria and testing.

      1) Includes procedures for ascertaining proper vibration isolation and operation. Refer to para. 1.06 Quality Assurance.

   e. American Society for Testing and Materials (ASTM)
      A-123 Zince (Hot Galvanized) Coatings on Products, etc.
      D-395 Compression Set of Vulcanize Rubber, Test for
      D-412 Tension Testing of Vulcanized Rubber
      D-573 Accelerated Aging of Vulcanized Rubber by the Oven Method, Test for
      D-624 Tear Resistance of Vulcanized Rubber, Test for
      D-797 Young's Modulus in Flexure, etc.
      D-1149 Accelerated Ozone Cracking of Vulcanized Rubber, Test for
      D-2240 Indentation Hardness of Rubber and Plastics by Means of a Durometer, Test for American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRA) Systems Manual (1989)
      American National Standards Institute (ANSI)
      S3.29 (1983) Guide to the Evaluation of Human Exposure to Vibration in Buildings

2.9 ELECTRICAL CONTROL AND INTERLOCKING WIRING

A. The electrical contractor shall furnish and install power wiring 480/208 volt, 120 volt connection only to all Medical/Dental equipment connected equipment and pumps including panels and motors. This subcontractor shall mount panels and shall furnish and install all control and interlocking wiring for each piece of medical gas and vacuum equipment including but not limited to remote alarms and local alarms for all medical gas equipment, medical gas alarms, pressure switches, flow switches and solenoid valves. All control wiring and interlocking wiring shall be installed in conduit and in accordance with the respective manufacturer's requirements and all connections shall be provided by the Plumbing Subcontractor. Wiring and conduit provided by this subcontractor shall be installed in accordance with the requirements of the Electrical SECTION 16000 of the specifications.

B. All electrical panels and life support panels shall be equipped with connection for emergency power hook-up, and/or the building automation system as required.

2.10 DENTAL VACUUM PUMPS

2.11 DENTAL AIR SYSTEM

2.12 INDUSTRIAL AIR SYSTEM

PART 3 - INSTALLATION

3.1 VALVE TAGS AND CHARTS

A. All valves on pipes of every description shall have neat circular brass vale tags of at least 2" in diameter, attached with brass hooks to each valve stem. The vale number shall be stamped on the brass tag. The numbers shall be consecutive. In addition, each valve shall have a properly completed cardboard valve tag which shall note Tag #, Valve #, System, Control Area, Building and Special Instructions. Tag to be Brady or Approved Equal. Tags and chains shall be extended from valve to just above ceiling tile.

B. Tag numbers shall correspond to numbers indicated for valves on the record drawings and on three printed detailed lists. These printed lists shall state the number and location of each valve and the area which it controls and other necessary information, such as requiring the opening or closing of another valve or valves, when any one valve is to be opened or closed.

C. Printed detailed lists shall be presented to and approved by Engineer before the space is occupied. This list shall be submitted in electronic file format as approved by Engineer.

3.2 IDENTIFICATION

A. All labeling of piping, materials, and equipment, as outlined hereinafter for identification purposes, shall be performed by this Subcontractor.

B. The pipe markers shall be installed on the apparatus in full view and shall be a color that is in sharp contrast with the background. Color coding to be in accordance with the standards outlined in the American Hospital Association latest publication.

C. Before markers are applied, the apparatus shall be thoroughly cleaned and painted, if necessary.

D. Letters shall not be less than 1-1/2" in height. Arrows shall not be less than 9" long.

E. All medical gas and dental piping systems exposed, above removable ceilings, and above furred spaces, shall be identified at intervals of approximately 20', at each change of direction and on both sides of walls for pipes passing through walls.

F. Piping systems shall be identified with approved snap-on covers designating services and direction of flow. Location of identification covers shall be near access panels wherever possible on both sides of valves. The markers shall be as manufactured by W.H. Brady Company, Westline Products, Seton Nameplate Company or approved equal.

G. The following Engineering Standard is based on NFPA 99-2010 and piping shall be marked as noted.

SYSTEM	BACKGROUND	LETTER
Oxygen	Green	White
Dental Vacuum	White	Black
Dental Air		
Nitrous Oxide		
Industrial Air		

3.3 CORE DRILLING

A. All core drilling required for the installation of the Medical Gas & Dental systems is to be done by this Plumbing and Vacuum Subcontractor. This Subcontractor is to carry all costs for core drilling. The Construction Manager will not be responsible for any circular penetrations required for the proper installation of the plumbing systems. Locate all required openings and prior to coring, coordinate the opening with the Construction Manager and all other trades. Do not disturb the existing systems. Thoroughly investigate the existing conditions in the vicinity of the required opening prior to coring. This Subcontractor shall be responsible for damages to the building and its systems from the coring operations. Disturbances from coring shall be kept to a minimum.

3.4 MEDICAL GAS AND DENTAL AIR INSTALLATION

A. The entire medical gas and dental air system shall be installed in accordance with NFPA 99-2010 except where amended by these specifications.

B. All tools used on medical gas/dental air piping shall be separate from tools used by other trades. Installers shall present certification documentation before beginning work.

C. The installation of equipment and individual components shall be made in accordance with the instructions of the manufacturer. These instructions shall be submitted to the owner and made part of the contract specifications.

D. All piping, valves, fittings and components for medical gas and medical vacuum use shall be supplied cleaned, prepared and certified for medical oxygen service by the manufacturer and be received sealed on the job.

E. Piping

1. Pipe shall be cut square with a tubing cutter with sharp cutting wheels. All burred ends of all piping and tubing shall be reamed to full bore of the pipe or tube and all chips shall be removed. Tools used in cutting and reaming shall be kept free from oil, grease or other lubricants not suitable for medical oxygen service. All cuts shall be cleaned and restored to original pipe dimensions. Where contamination has occurred, the items affected shall be re-cleaned in accordance with NFPA 99 2010. Joints shall be brazed within one hour of being cleaned.

2. All brazing shall be performed according to ANSI/AWS C3.4. Brazed joints shall be considered Class B brazed joints. While brazing, all joints shall be continuously purged with dry nitrogen.

3. During and after installation, openings in the piping shall be kept capped or plugged, except that during brazing, a discharge hole (holes) shall be provided to allow the discharge of purge gas. During brazing, the purge gas flow rate shall be maintained at a level that will not produce excessive positive pressures in the piping system. The flow of purge gas shall be maintained until the joint is cool to the touch. After brazing, the discharge hole (holes) shall

be plugged or capped.

4. All joints in the piping shall be made with silver bearing copper-phosphorus (BCuP) brazing alloy (melting point at least 1000 degrees F). The use of flux is prohibited. The outside of the tube and fittings shall be cleaned by washing with hot water and a stainless steel brush after brazing.

5. Each brazed joint shall be visually examined after cleaning. The following conditions shall be considered unacceptable:

   a. Flux or flux residue.
   b. Excessive oxidation.
   c. Presence of unmelted filter metal.
   d. Failure of the filler metal to be clearly visible all the way around the joint at the interface between the socket and the tube.
   e. Cracks in the tube or component.
   f. Cracks in the braze filler metal.
   g. Failure to hold the test pressure.

6. Defective brazed joints shall be replaced. No joint shall be repaired. Cracked joints or joints exhibiting excessive oxidation shall be replaced.

7. Threaded joints shall be kept to a minimum.

8. Identify and permanently mark all piping as it is installed with pre-approved labels and direction arrows. Labeling shall be applied at intervals of not more than 20 feet, at least once in each room and at each story traversed by the pipe. All labels must be positioned to be easily seen and read.

9. Piping shall be supported from the building structure in accordance with MSS Standard Practice SP-69, Piping Hangers and Supports - Selection and Application. Hangers and supports shall comply with MSS Standard Practice SP-58, Piping Hangers and Supports - Materials, Design and Manufacture. Portions of hangers in contact with copper tube shall have a copper finish or other protection against galvanic corrosion. Maximum support spacing shall be as follows:

_ in. nominal	5 ft.
½ in. nominal	5 ft.
¾ in. nominal	5 ft.
1 in. nominal	5 ft.
1¼ in. nominal	6 ft.
1½ in. nominal and larger	10 ft.

10. After installation of the piping, but before installation of the outlet valves, the lines shall be blown down (purged) by means of dry nitrogen. NOTE: Large lines should be purged before small lines are attached.

11. Change of direction in medical vacuum piping shall be made with T-fitting and cleanout plug. The cleanout shall be made with a wrought copper street male adapter with cast brass cap. The cleanout shall be accessible for rodding.

F. Valves and Gauges

1. Furnish and install any and all valves including purge valves, required to isolate sections of the piping systems extending into areas for construction at a later date. Provide all valves to properly test each system with respect to the construction phasing and as essentially indicated on the drawings. Provide all required adapters, valves and interconnecting tubing required to perform the medical gas testing as required by the Hospital. Identify all isolation and phasing valves as such and indicate on tag or plastic sign that valve is to remain open and that anesthesia department is to be notified if closed.

2. Install isolation valves on laterals adjacent to risers.

3. Lock in open position all main, section, and riser valves.

4. Zone valves (MGCV) services shall be in the following top to bottom sequence: oxygen, and medical vacuum. This sequence shall be maintained where two zone valve boxes are required for a given location.

3.5 MEDICAL GAS TESTING AND CERTIFICATION

A. General

1. This subcontractor shall be responsible for the testing of all medical gas (oxygen, nitrous oxide & dental air) systems as outlined in NFPA 99 2010. Note additional requirements contained within this specification as well as in NFPA-99.

2. The testing shall include all components of the system or portions thereof, including but not limited to, gas bulk sources(s), local alarms and monitoring safeguards, master alarms, pipelines, isolation valves, area alarms, zone valves, station outlets, and terminal outlets.

3. This subcontractor is to provide purge valves and isolation valves at all dead ends and points of connections to piping systems or at all phasing break points for the proper execution of testing and certification.

4. This subcontractor shall be responsible for supplying the bottled gas, gauges, adapters, analyzer and all other necessary equipment to conduct the testing and certification.

5. Testing shall be performed in the following sequence and shall be completed prior to use of the system for patient care.

COLUMN ACCEPTANCE TEST

Purge test

INSTALLATION TESTS

Blowdown test
Initial pressure test
Cross-connection test
Purge test
Pressure test

CERTIFICATION TESTS

Cross-connection test
Valve test
Flow test
Alarm test
Purge test
Purity test
Gas source test
Outlet Test
Final tie-in test
Operational pressure test
Concentration test

7. All installation tests shall be performed by the installer or representative prior to the certification tests. Test gas shall be oil-free dry nitrogen.

8. All certification tests shall be performed and certified by an independent (not the installation contractor) medical gas testing contractor/laboratory. The testing contractor shall have a minimum of 5 years experience in the testing of medical gases. The testing laboratory used shall be state certified. The Plumbing Contractor shall hire the certification contractor directly. The testing contractor shall submit a shutdown management plan before any work is begun. Test gas, up to and including the purity test, shall be oil-free dry nitrogen. The balance of certification tests shall be with the gas of system designation. **The Plumbing Subcontractor shall assist as required the Medical Gas Certifier in all certifications.**

9. This subcontractor shall submit installation test reports and results to the architect/engineer or his representative for review. Installation test reports shall note date, time and pressure readings for tests sections as well as results of blowdown, purge and cross-connection tests for tested sections and outlets. Certification test reports, certified by the independent laboratory, shall note date and time of tests on a room-by-room, outlet-by-outlet, valve-by-valve, alarm-by-alarm format.

B. Column Acceptance Test

1. Purge Test

a. In order to remove particulate matter in the pipelines, a heavy, intermittent purging of the pipe line shall be done. The appropriate adapter shall be obtained, and a high-flow purge shall be put on each outlet. The outlet shall be allowed to flow fully until the urge produces no discoloration in a clean white cloth.

C. Installation Tests

1. Blowdown Test

a. After installation of the piping but before installation of station outlets and other medical gas components, the lines shall be blown clear.

2. Initial Pressure Test

a. Before attachments of system components (e.g. pressure activating switches for alarms, manifolds, pressure gauges or pressure relief valves), station outlets, with test caps in place, and before closing walls and ceilings, each section of the piping system shall be subjected to a test pressure of 150 PSIG. This test pressure shall be maintained until each joint has been examined for leakage by means of soapy water or other equally effective means of leak detection safe for use with oxygen. The source shutoff valve shall be closed. Leaks, if any, shall be located, repaired and retested in accordance with this paragraph.

b. Nitrogen systems shall be tested similarly, except test pressure shall be (250) PSIG.

3. Cross-Connection Test

a. Prior to closing the walls, it shall be determined that no cross-connection of piping systems exists. Test procedures shall be those as outlined in NFPA 99-2010.

4. Purge Test

a. In order to remove particulate matter in the pipelines, a heavy, intermittent purging of the pipe line shall be done. The appropriate adapter shall be obtained, and a high-flow purge shall be put on each outlet. The outlet shall be allowed to flow fully until the purge produces no discoloration in a clean white cloth.

5. Pressure Test

a. After the completely assembled station outlets and all other medical gas system components have been installed, all piping systems shall be subjected to a 24-hour standing pressure test at 20 percent above the normal operating line pressure. After the piping system is filled with the test gas, the supply valve and all outlets shall be closed and the source of test gas disconnected, the piping system shall remain leak-free for 24 hours. Leaks, if any, shall be located, repaired, and retested in accordance with this paragraph.

D. Certification Tests

1. Cross-Connection Test

    a. After closing of walls and completion of installation tests, it shall be determined that no cross-connection of piping systems exists. Test procedures shall be those as outlined in NFPA 99-2010. Vacuum inlets shall be tested for cross-connections at this time.

2. Valve Test

    a. Valves installed in each medical gas piping system shall be tested to verify proper operation and rooms, areas and outlets of control. Records shall be made listing the rooms, areas and outlets controlled by each valve for each gas. The information shall be utilized to assist and verify the proper labeling of the valves.

3. Flow Test

    a. Oxygen outlets shall deliver 3.5 SCFM with a pressure drop of no more than 5 PSIG and maintain a residual pressure of 50 PSIG.

4. Alarm Test

    a. All warning systems, including local alarms, area alarms and master alarms, shall be tested to ensure that all components function properly. Permanent records of these tests shall be maintained. Test limits shall be those as outlined in NFPA 99 2010.

5. Purge Test

    a. In order to remove any traces of particulate matter deposited in the pipelines as a result of construction, a heavy, intermittent purging of the pipelines shall be done. Test procedure shall be as outlined in NFPA 99 2010.
    b. For each positive-pressure gas system, cleanliness of piping system shall be verified. Filter a minimum of 35 cubic feet of gas through a clean, white 0.45 micron filter at a minimum flow of 3.5 SCFM. Filter shall show no discoloration, and shall accrue no more than 0.1 mg. of matter. Each outlet shall be tested with the outlet most remote from the zone valve to be the last outlet tested.

6. Purity Test

    a. For each positive-pressure system the test (source) gas shall be tested for dew point,

total hydrocarbons (as methane), and halogenated hydrocarbons. The test results shall be utilized as noted below.

b. For each positive-pressure system, each outlet shall be tested for dew point, total hydrocarbons (as methane) and halogenated hydrocarbons. The test results shall be utilized as noted below.

c. Results of the source gas test and outlet tests as described above shall be compared. The maximum allowable variation between the test results shall be:

Dew point	5°C @ 50 PSIG
Total hydrocarbon as methane	± 1 PPM
Halogenated hydrocarbons	± 2 PPM

7. Final Tie-In Test

a. After connection to the new system, this final connection shall be leak-tested with the gas of system designation at the normal operating pressures. This pressure shall be maintained until each joint has been examined for leakage by means of soapy water or other equally effective means of leak detection safe for use with oxygen.

8. Operational Test

a. Oxygen outlets shall deliver 3.5 SCFM with a pressure drop of no more than 5 PSIG and residual pressure of 50 PSIG.

9. Concentration Test

a. After purging each system with the gas of system designation, each pressure gas source and outlet shall be analyzed for concentration of gas by volume. Analysis shall be with instruments designed to measure the specific gas dispensed. Allowable concentrations shall be within the following:

Dental Air	99+% oxygen
Oxygen	99+% oxygen
Nitrous Oxide	99+% oxygen

3.6 MEDICAL GAS CONNECTED EQUIPMENT

A. Furnish and install shutoff valves at each piece of equipment. Obtain exact roughing in dimensions from manufacturers of all service locations before connecting to or roughing for equipment.

B. Equipment shall be furnished and set under another Section of the Specifications. Roughing for and final connections to including piping shall be provided by this Contractor.

3.7 MEDICAL GAS INSTALLERS

A. All workers on medical gas and vacuum systems must have the proper qualifications, certification and copies of licenses and certificates must be provided to the Owner prior to the start of the work. It is

preferred that the installing contractor utilize a separate and distinct group of his workers dedicated to the medical gas system installation for the duration and completion of the project.

END OF SECTION

SECTION 15480 - DENTAL/MEDICAL GAS AND VACUUM SYSTEMS

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SECTION 15600 - HVAC

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PART 2- PRODUCTS

SECTION 15600 – HVAC

1 PART 1 – GENERAL

1.1 REFERENCES

A. All of the Contract Documents, including General and any Supplementary Conditions and Division 1- General Requirements, apply to the work of this Section.

B. Examine all Drawings and all other Sections of the specifications for requirements herein affecting the work of this trade.

C. This specification requires a preparation and submissions of drawings and other documents, procurement of approvals and provision of a complete functional HVAC system. As a result, this Section serves dual purposes of providing specifications and indicating design criteria for the HVAC Subcontractors use and guidance in preparing HVAC installation drawings and other documents for approvals.

D. The bid for work under Section 15480 shall be included with this bid.

1.2 DEFINITIONS

A. Words in the singular shall also mean and include the plural, wherever the context so indicates and words in the plural shall mean the singular, wherever the context so indicates.

B. Wherever the terms “shown on drawings” are used in the specifications. They shall mean “noted”, “indicated”, “scheduled”, “detailed”, or any other diagrammatic or written reference made on the drawings.

C. Wherever the term “provide” is used in the specifications it will mean “furnish” and “install”, “connect”, “apply”, “erect”, “construct”, or similar terms, unless otherwise indicated in the specifications.

D. Wherever the term “material” is used in the specifications it will mean any “product”, “equipment”, “device”, “assembly”, or “item” required under the Contract, as indicated by trade or brand name, manufacturer’s name, standard specification reference or other description.

E. The terms approved”, or “approval” shall mean the written approval of the Architect.

F. The term “specification” shall mean all information contained in the bound or unbound volume, including all “Contract Documents” defined therein, including all drawings.

G. The terms “directed”, “required”, “permitted”, “ordered”, “designated”, “prescribed” and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect. The terms “approved”, “acceptable”, “satisfactory” and similar words shall mean approved by, acceptable or satisfactory to the Architect. The terms “necessary”, “responsible”, “proper”, “correct” and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.

H. "Piping" includes in addition to pipe or mains, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

I. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.

J. "Exposed" means not installed underground or "concealed" as defined above.

K. "HVAC Sub-Contractor", refers to the Sub-Contractor or his Sub-Contractors responsible for furnishing and installation of all work indicated in the HVAC specifications and as shown on the HVAC drawings.

1.3 SCOPE OF WORK

A. Work Included: The scope of work, without limiting the generality thereof, consists of furnishing all labor, materials, plant, transportation, equipment, accessories, appurtenances, and services necessary and/or incidental to the proper completion of all HVAC work shown on the drawings, described in the specifications, or as reasonably inferred from either, in the opinion of the Architect, as being required, and includes, but is not limited to:

All work in Section 15600 HVAC
Coordination with DDC control vendor
Insulation
HVAC equipment
Instructions to Owner
Core drilling
Furnishing of access panels
Building automation system connections
Testing, disinfection and certification
Connections to HVAC connected equipment furnished under other sections
Valves and accessories
Cleanouts
Boilers
Record coordination drawings - CADD Submission
Thermostatic master mixing valves
Hangers, sleeves and appurtenances
Interlocking and control wiring
Cleaning and adjusting
Staging, scaffolding and rigging
Seismic restraints
Assist in commissioning of systems
Installation of fireproofing sleeves
Miscellaneous iron and steel

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. Electrical Work - Section 16100.

B. Finish Painting - Section 09900.

C. Temporary power for operation of pipe cutting, welding and threading tools - Section 01500

D. Fire Protection Work - Section 15300.

E. Heating Work - Section 15600

F. Concrete housekeeping pads - Section 03300.

G. Installation of access panels - Trades in which they occur.

H. Excavation, backfill and resurfacing - Earth Work - Section 02200.

I. Drainage structures and appurtenances - Section 02700. Beyond 10 feet.

J. Toilet accessories - Section 10800.

K. Site utilities beyond 10 feet from building

L. Furnishing of fire stop material

M. Building Commissioning

1.5 CODES, STANDARDS AND REFERENCES

A. All materials and workmanship shall comply with all applicable State Codes, Specifications, Local and State Ordinances, Industry Standards, Utility Company Regulations and latest editions.

B. In case of difference between State Building Codes, State Laws, Local Ordinances, Industry Standards, Utility Company Regulations and the Contract Documents, the HVAC Subcontractor shall promptly notify the Architect in writing of any such difference.

C. In case of conflict between the Contract Documents and the requirements of any Code, Authorities having jurisdiction, the most stringent requirements of the aforementioned shall be included in the bid and assume that will be provided unless otherwise directed by the Architect after award of Contract.

D. Should the HVAC Subcontractor perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations, he shall bear all costs arising in correcting the deficiencies, as approved by the Architect.

E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations, and the applicable requirements of the following accepted Codes and Standards, without limiting the number, as follows.

1. Local and state building, HVAC, mechanical, electrical, fire and health department codes.
2. National Fire Protection Association (NFPA)
3. Occupational Safety and Health Act (OSHA)
4. Building Owner's Insurance Company
5. Underwriters' Laboratories (UL)
6. International Building Code 2006 (including 2006 NH Supplement)
7. Recommendations of the National Fire Protection Association (NFPA), in general and in particular: Life Safety, NFPA 101, JCAHO – Joint Commission Accreditation Healthcare, JCAHO – Interim Life

F. In these specifications, references made to the following Industry Standards and Code Bodies are intended to indicate the accepted volume or publication of the Standard. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:

1.	ANSI	American National Standards Institute
2.	ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
3.	ASME	American Society of Mechanical Engineers
4.	ASTM	American Society of Testing Materials
5.	AWS	American Welding Society
6.	CS	Commercial Standards, U.S. Department of Commerce
7.	FM	Factory Mutual
8.	NFPA	National Fire Protection Association
9.	CGA	Compressed Gas Association
10.	FS	Federal Specification, U.S. Government
11.	HI	Hydraulics Institute
12.	MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
13.	NEMA	National Electrical Manufacturers Association
14.	OSHA	Occupational Safety and Health Act
15.	UL	Underwriters' Laboratories, Inc.

G. The HVAC Subcontractor for the work shall give all necessary notices, obtain all permits, pay all governmental taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. The HVAC Subcontractor shall obtain and pay for all required Certificates of Inspection for his work and deliver same to the Architect before request for acceptance of his portion of work is made and before final payment.

1.6 GUARANTEE

A. Attention is directed to provisions of the General Conditions and Supplementary General Conditions regarding guarantees and warranties for work under this Contract.

B. Manufacturers shall provide guarantees for work under this Contract. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and the Contractor may have by Law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the systems, as determined by the Architect and shall remain in effect for a period of (12) months thereafter.

C. All materials, items of equipment and workmanship furnished under each Section shall carry the standard warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the HVAC Subcontractor including all other damage done to areas, materials and other systems resulting from this failure.

D. The HVAC Subcontractor shall guarantee that all elements of the systems provided under his Contract, are of capacity to meet the specified performance requirements as set forth herein or as indicated on the drawings.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the HVAC Subcontractor, within (5) working days, at no cost to the Owner.

F. The HVAC Subcontractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

G. Upon final acceptance of the project by the Owner, the (1) year guarantee period of all equipment and materials will be initiated. During this period, the Contractor shall make a minimum of (2) visits to the site (6) months after acceptance and immediately prior to the end of the guarantee period). These visits shall be performed in the presence of the Owner's representative. During each visit, the Contractor shall thoroughly check all equipment for proper operation and respond to any list of deficiencies prepared by the Owner. Formal reports shall be generated and forwarded to the Department of Engineering and Architect's Office describing the systems inspected, date of inspection and status of equipment.

1.7 THE SUBCONTRACTOR

A. The HVAC Subcontractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications and shall take all responsibility for and bear all losses resulting to him in the execution of his work.

B. The HVAC Subcontractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed directly or indirectly by the HVAC Subcontractor shall perform their work according to all the conditions as set forth in these specifications.

C. The HVAC Subcontractor shall furnish all materials and do all work in accordance with these specifications and any supplementary documents provided by the Architect. The work shall include every item shown on the drawings and/or required by the specifications as interpreted by the Architect. All work and materials furnished and installed shall be new and of the best quality and workmanship. The HVAC Subcontractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed

1.8 COORDINATION OF WORK

A. The HVAC Subcontractor shall compare his drawings and specifications with those of other Trades as well as the Architectural drawings and specifications, and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the HVAC work. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, HVAC Subcontractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the HVAC work caused by the HVAC Subcontractor's neglect, shall be made by him at his own expense, to the Architect's satisfaction. The HVAC Subcontractor must include in his bid sufficient dollar amounts to coordinate the work of this Contract. This project is complex and will require additional time to coordinate all Trades and allow implementation of Yale New Haven Hospital Standards and maintenance serviceability requirements. This requirement shall include, but not be limited to, producing the coordination drawings, as many times and as many drawings as required, to ensure serviceability of equipment, as approved by the Owner.

B. Locations of pipes and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. The HVAC Subcontractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component.

C. Lines which pitch shall have the right-of-way over those which do not pitch, For example: waste piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.

D. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The HVAC Subcontractor shall provide cleanouts and drains as required for his work to effect these offsets, transitions and changes in direction.

E. All work shall be installed in a way to permit removal (without damage to other parts) of coils, filters, control appurtenances, shafts, sheaves and drives and all other system components provided under this Contract requiring periodic replacement or maintenance. All piping shall be arranged in a manner to clear the openings of swinging overhead access doors as well as ceiling tiles. All work shall be done to allow easy access for maintaining equipment. The Owner and Engineer will require proof via the preparation of large scale sections and part plans that valves, cleanouts, etc. are accessible after the work is completed. Any items in the field discovered to be in non-compliance shall be removed and relocated, as required, and as directed by the Architect.

F. The Contract Drawings are diagrammatic only intending to show general runs and locations of piping, equipment, terminals and specialties and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom.

G. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, flow switches, etc., exist, such conflicts shall be reported to the Architect during bidding and prior to signing of the Contract. If such action is not taken, the HVAC Subcontractor shall furnish such items as part of his work as necessary, for complete and operable systems and equipment, as determined by the Architect.

H. The HVAC Subcontractor shall coordinate the installation of all equipment and any catwalks or service platforms provided.

I. Where drawing details, plans, specification requirements and/or scheduled equipment capacities are in conflict and where pipe sizes of same pipe are shown to be different between plans and/or between plans and sections or details, the most stringent requirement will be included in the Contract. HVAC systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.

J. Final location of all exposed control valves, access panels, fixtures, control devices, wall hydrants, hose bibbs etc., shall be coordinated with the Architectural reflected ceiling plans and/or other Architectural details, as applicable. Obtain approval of locations of all devices from Architect in the field. Equipment shown on the HVAC and/or Architectural drawings to be provided with services, shall be included under this Contract as applicable, including all piping connections to systems, to make equipment complete and operable. Additional piping, flexible fittings, etc., shall be provided to accomplish the above requirement, as required, all as part of this Contract, at no extra cost to the Owner. This requirement necessitates that the HVAC Subcontractor review the architectural drawings and the drawings of other Trades during bidding to ascertain the extent of all requirements, and interface between the Trades and scope of work.

K. The HVAC Subcontractor shall coordinate his work with other Trades' work so that all equipment and systems can be easily, safely and properly serviced and maintained. It is imperative that service personnel can safely access all equipment. Provide safety rails, steps, ladders, valve chains, handle extensions, etc. as required, in addition to the ones shown on the drawings, to ensure safe and easy access to all equipment and is provided in a manner approved by the Architect and the Owner's Project Manager

1.9 GIVING INFORMATION

A. The HVAC Subcontractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the Architect and other Contractors sufficiently in advance of the work so that all openings may be built in advance.

1.10 EQUIPMENT AND MATERIALS

A. Equipment and materials shall be delivered to the site and stored in location as directed by the Architect, in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls, filters, etc., shall be stored in dry, heated spaces.

B. The HVAC Subcontractor shall have his equipment tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned, polished thoroughly and turned over the Owner in a condition satisfactory to the Owner and Architect. Damage or defects developing before acceptance of the work shall be made good at the HVAC Subcontractor's expense.

C. The HVAC Subcontractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his Trade and shall furnish

and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.

D. The manufacturers listed within this specification establish the standards of quality required, either by description or by references to brand name, name of manufacturers or manufacturer's model number. Where one product only is specifically identified by name or manufacturer's model number, the HVAC Subcontractor shall base his bid on the use of the name product. Where multiple names are used, the HVAC Subcontractor shall base his bid on the use of any of those products named. The HVAC Subcontractor shall submit with his bid, the names of products which are proposed as substitutions for products named in the specifications. Each proposed substitution shall be accompanied by a written statement of money to be added or deducted from his bid. The Owner reserves the sole right to accept or reject said substitutions with or without cause. When equipment and/or materials are proposed to be purchased from a manufacturer other than those specified, the HVAC Subcontractor shall provide with his bid, data sufficient to inform the Owner and Engineer of the basis of equality of the substitution to that of the equipment and/or materials specified. When equipment other than that specified is used, the HVAC Subcontractor shall be solely responsible for any extra cost of required revisions such as structural steel, concrete, electrical, piping, and any engineering review, coordination with other Trades, or redesign, etc. Such additional cost shall be identified at the time such substitutions are proposed and incurred by the HVAC Subcontractor.

E. Manufacturers' directions shall be followed completely in the delivery, storage, protection and installation of any equipment. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's written instructions before proceeding with the work. Should the HVAC Subcontractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.

F. The HVAC Subcontractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.

F. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of the HVAC Subcontractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, the HVAC Subcontractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the HVAC Subcontractor shall make all necessary changes in all affected related work provided under other Sections including location of roughing-in connections by other Trades, electrical requirements, piping, supports, insulation, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.

H. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. Equipment and materials shall be products which will meet with the acceptance of the Authorities having jurisdiction over the work and as specified hereinbefore. Where such acceptance is contingent upon having the products listed or labeled by FM, UL or other testing laboratories, the products shall be so listed or labeled. Where no specific indication as to the type or quality of material or equipment is indicated, a first class standard article shall be provided.

I. All equipment of one type (such as valves, piping, heaters, well water system components, drainage specialties, etc.), shall be the product of one manufacturer.

J. Equipment furnished by the Owner, if assigned to the HVAC Subcontractors, shall be received, inspected, installed, etc., as if they were purchased by the HVAC Subcontractor. All guarantees, service contracts, etc., shall be the same as for all other equipment provided under this Contract. Make all connections, and provide all piping and controls as necessary.

1.11 CUTTING AND PATCHING

A. The HVAC Subcontractor shall be responsible for all core drilling, as required for work under his Contract, but in no case shall he cut into any structural elements without the written approval of the Architect.

B. All cutting, rough patching and finish patching shall be provided under this Contract.

C. All concrete and masonry equipment bases and pads shall be provided by the Other Work Contractor.

1.12 USE OF PREMISES

A. The HVAC Subcontractor shall confine all of his apparatus, storage of materials and construction to the limits indicated on the drawings and directed by the Architect and he shall not encumber the premises with his materials.

B. In storing materials within areas (structure or ground), or when used as a shop, the HVAC Subcontractor shall consult with the other work Contractor and shall restrict his storage to space designated for such purposes. The HVAC Subcontractor will be held responsible for repairs, patching or cleaning arising from any unauthorized use of premises.

C. Notwithstanding any approvals or instructions which must be obtained by the HVAC Subcontractor from the Architect in connection with use of premises, the responsibility for the safe working conditions at the site shall remain the HVAC Subcontractor's and the Architect or Owner shall not be deemed to have any responsibility or liability in connection therewith.

1.13 PROTECTION

A. All materials such as valves, fittings, piping, etc., shall be properly protected and all piping openings shall be temporarily closed by the HVAC Subcontractor installing same, so to prevent obstruction and damage. The HVAC Subcontractor shall take precautions to protect his materials from damage and theft.

B. The HVAC Subcontractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or electrical systems provided under his Contract.

1.14 DAMAGE TO OTHER WORK

A. The HVAC Subcontractor shall be held responsible and shall pay for all damages caused by his work to the new building structures and equipment, piping, etc., and all work and finishes installed under this Contract in the new or in existing building. Repair of such damage shall be done as hereinbefore specified, at the expense of the HVAC Subcontractor and to the Architect's satisfaction.

1.15 CORRECTION OF WORK

A. The HVAC Subcontractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after completion of work and whether or not fabricated, installed or completed. The HVAC Subcontractor shall bear all costs of correcting such rejected work.

B. The above requirements will also apply to work observed to be in conflict with 15400-1.8 "Coordination of Work" as it relates to installations not allowing accessibility to all system components.

1.16 EXTRA WORK

A. No claim for extra work will be allowed unless it is authorized by the Architect in writing before commencement of the extra said work.

1.17 TOUCH-UP PAINTING

A. The HVAC Subcontractor shall thoroughly clean all equipment and systems provided under this Contract from rust, splatters and other foreign matter or discoloration, leaving every part of each system in an acceptable prime condition. The HVAC Subcontractor, for the work under his Contract, shall refinish and restore to the original condition all equipment and piping which has sustained damage to the manufacturer's prime and finish coats of paint and/or enamel.

1.18 PIPE SLEEVES, PLATES AND ESCUTCHEONS, FIRESTOPPING AND SMOKEPROOFING

A. Where pipes pass through all walls and floors, the HVAC Subcontractor shall provide and set individual sleeves for each pipe and all other work under his charge, as necessary for passage of all pipes. Sleeves shall be of sufficient size to provide 1/2" air space around the pipe passing through (including insulation where pipes are insulated). Where pipes are to be insulated, insulation shall run continuous through sleeves. All openings shall be sealed, smokeproofed and made tight. The HVAC Subcontractor shall be responsible for the exact location of sleeves provided under this Contract and shall coordinate all requirements for piping sleeves.

B. The HVAC Subcontractor, for work under his charge, shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation, and he shall prepare sleeving and opening drawings for the use of these drawings by the other work contractor.

C. Sleeves and inserts shall not be used in any portions of the building, where their use would impair the strength or construction features of the building. Elimination of sleeves must be approved by the Architect.

D. Provide chrome-plated brass escutcheons with set screw for exposed piping, in all areas except in mechanical rooms. In these areas use plain brass or cast iron escutcheons suitable for painting. All escutcheons shall be sized to fit the bare pipe or insulation in a snug and neat manner. They shall be of sufficient size to cover sleeved openings for the pipes and of sufficient depth to cover sleeves projecting above floors. Escutcheons shall be as manufactured by Beaton & Caldwell, Dearborn Brass or Grinnell.

E. Pipe sleeves shall be required on all pipes passing through all walls and shall be made of Schedule 40 pipe, 16 gauge galvanized steel or 16 gauge steel as follows:

1. Sleeves on pipes passing through masonry or concrete construction shall be Schedule 40 pipe.
2. Sleeves on pipes passing through drywall construction shall be 20 gauge galvanized steel.
3. Sleeves on pipes passing through fire rated drywall partitions shall be 16 gauge steel.
4. Exterior wall sleeve through masonry walls shall be made watertight by the use of Mechanical Link Seal Joint as MFG by Century Products MFG.

F. Pipe sleeves shall be set as follows:

1. Set sleeves 1" above finish floor (3" at penthouses and mechanical rooms) and flush on each side of walls, except sleeves through floor occurring in walls and partitions shall terminate 1" above the finished floor.
2. Sleeves shall be set securely in place before concrete is poured.

G. The HVAC Subcontractor shall firestop or smokestop the space between the sleeves provided under his Contract and pipes as applicable, as follows:

1. Materials shall bear label issued by qualified laboratory and specifically indicating that the product has been tested to ASTM E814 Standard, shall be as manufactured by Bio Fireshield Inc. or Dow Corning Corp., and shall include the following:
   a. Dow Corning silicone RTV foam (penetration fill material) complete.
   b. Dow Corning 96-081 RTV silicone adhesive sealant.
   c. Mineral fiber board, mineral fiber matting, and mineral fiber putty may be utilized for forming and damming materials used to contain the liquid silicone RTV foam mixture prior to and during foam-filling penetrations. Damming and forming materials shall be fire tested and functionally approved and shall be capable of being left in place to become an integral part of the foamed penetration wall.

2. Materials shall be delivered in their original, tightly sealed containers or unopened packages, all clearly labeled with the manufacturer's name, product identification and lot numbers where appropriate.

3. Installation shall comply with the following:
   a. Penetration seal preparation shall include use of the procedures, techniques and quality control standards recommended by the product manufacturer, as follows:
   b. Remove all incidental combustible materials and loose impediment from the penetration opening and involved surfaces.
   c. Remove free liquids or oil from all involved surfaces and penetration components.
   d. Install the specified damming materials to accommodate and insure the proper thickness/fire rating requirements and provide containment during foaming.
   e. Foam mixing and dispensing of equipment and materials shall be in strict accordance with manufacturer's instructions.
4. The materials installation procedures, clean-up, safety precautions and requirements shall be in accordance with Dow Corning published information relative to "Safe Handling Procedures", use of safety shoes, goggles, etc.

5. All firestopping materials must be applied in direct accordance with their UL label certification.

6. The HVAC Subcontractor shall submit a mockup of every type of firestopping method used on this project for approval by the Architect at the site. The firestopping methods must be approved prior to installation of systems.

H. Except as otherwise specified, underground piping passing through exterior walls, foundation slabs on grade, or manhole walls, shall have penetration closures of the modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous belt around the pipe and with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between the pipe and wall, reducing chances of cathodic reaction between these members. The HVAC Subcontractor for work under his charge shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation. The inside diameter of the wall opening shall be sized to fit the pipe and ensure a watertight joint. Where applicable, when installing seals, take into account the pipe O.D. if non-standard due to coating or jacketing.

1.19 WATERPROOFING, FLASHING AND COUNTERFLASHING

A. Unless specifically indicated otherwise on the drawings, the HVAC Subcontractor shall provide all counterflashing and waterproofing of all piping and equipment provided by him, which pierce roofs, walls and other weatherbarrier surfaces. All work under this Section shall be coordinated with the Other Work Contractor.

B. All work shall be performed in a workmanlike manner to ensure weatherproof installation. Any leaks developed due to this Contractor's work shall be repaired at his expense, to the Architect's satisfaction.

C. Pipes passing through slabs shall have the sleeve extended above floors as hereinbefore specified to retain any water and the space between the pipe and sleeve caulked with lead wool. The top shall be sealed with lead and the bottom shall be sealed with monolastic caulking compound.

C. Subcontractor shall provide and install counterflashing to overlap the base flashing by 4". Flashing shall be fastened with matching clamp rings or by brazing, welding or soldering.

1.20 MISCELLANEOUS IRON AND STEEL

A. The HVAC Subcontractor shall provide all steel supports and hangers as shown on the drawings or required to support all equipment, systems or materials provided under this Contract.

B. All work shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets and framework shall be properly sized and strongly constructed.

C. Measurements shall be taken on the job and worked out to suit adjoining and connecting work. All work shall be done by experienced metal-working mechanics. Members shall be straight, true and accurately fitted.

D. Welded joints shall be ground smooth where exposed. Drilling, cutting and fitting shall be done as required to properly install the work and accommodate the work of other Trades as directed by them.

E. Members shall be generally welded except that bolting may be used for field assembly where welding would be impractical. Welders shall be skilled and certified. Bolts, nuts and washers shall be high tensile type, minimum 3/4" diameter, conforming to ASTM.

F. All shop and field fabricated iron and steel work shall be cleaned and dried and given (1) coat of rust inhibiting paint on all surfaces and in all openings and crevices.

1.21 ELECTRICAL WORK, MOTORS, MOTOR CONTROLLERS

A. The Electrical Subcontractor shall provide power wiring to all equipment provided under Section 15600. All control wiring shall be installed in conduits and in accordance with the respective equipment manufacturer requirements. All connections shall be provided by the HVAC Subcontractor. All conduit and wiring provided by the HVAC Subcontractor shall be installed in accordance with the requirements of Section 16100 of these Specifications.

B. Motors shall be built in accordance with latest Standards of NEMA and as specified. Motors shall be specifically and expressly wound for voltage required.

C. Motors shall be tested in accordance with ANSI 50 and conform thereto for insulation resistance and dielectric strength.

D. Motors shall be provided with adequate starting and protective equipment as specified or required and with conduit terminal box of size adequate to accommodate conduits and wires.

E. Capacity shall be sufficient to operate motors under job conditions of operation and load, without overload and shall be at least the horsepower size indicated or specified.

F. All motors shall be suitable for continuous duty at rated horsepower, with temperature rise not to exceed 40°C for dripproof motors, 50°C for splashproof motors, 55°C for totally enclosed motors. All motors shall be capable of 15% overload without overheating.

G. Direct connected motors shall be furnished with adjustable base. Motors connected to driven equipment by belt or shaft shall be furnished with adjustable sliding bases, except for fractional motors which shall be furnished with slotted mounting holes.

H. Motors smaller than 1/2 HP shall be capacitor, starter or split-phase type. Motors 1/2 HP and larger shall be squirrel cage, induction type. Motors 1 HP and larger shall have grease lubricated ball bearings and approved grease fittings.

I. All electrical apparatus and controls furnished as a part of the HVAC work shall conform to applicable requirements under Electrical Section.

J. The HVAC Subcontractor shall provide the Electrical Subcontractor with all motor size and wiring requirements within (15) days from date of Contract to allow proper coordination of Trades by the other work Contractor.

K. The HVAC Subcontractor shall verify with the Electrical Subcontractor available electrical characteristics before ordering any equipment or motors.

L. Equipment which includes a number of correlated electrical control devices mounted in a single enclosure or on a common base with equipment, shall be supplied for installation completely wired internally with terminal strip ready for external wiring. Unless specifically directed otherwise in the Contract Documents, if these control devices are separately mounted they shall be furnished by the HVAC Subcontractor and wired by Electrical Subcontractor in accordance with the manufacturer's wiring diagram, as shown on the drawings and as specified hereinafter.

1.22 IDENTIFICATION OF MATERIALS

A. All equipment used in the HVAC systems shall have a permanently attached nameplate identifying the manufacturer, service, size, serial number or model number, etc. The nameplates shall be kept clean and readable at all times.

B. Each item of equipment such as pumps, air compressors, vacuum pumps, etc., shall be identified by a permanently attached nameplate made of black surface, white core laminated bakelite with 1" high indented letters. Nameplates shall be minimum 5" long by 3" wide and bear the equipment name as designated in the specifications. Nameplates shall be as fabricated by Seton Nameplate Co., Atlantic Engraving Co., W.H. Brady Co., or approved equal. Attach with screws or rivets only.

C. A legend showing the service and an arrow indicating the direction of flow shall be applied on each pipe installed by the HVAC Subcontractor. Indication shall be by stencil and paint only, no "stick-ons" will be allowed.

D. The piping of each system shall be identified in the following locations and where directed by the Architect.

1. Pipe mains and branches - every 15’-0”.
2. At each valve.
3. Each wall penetration (both sides).
4. Each riser including branch risers from mains.
5. At each piece of equipment.

E. The identification of piping shall be coordinated with the Owner and comply with OSHA and ANSI A13.1 Standards for the identification of systems. Obtain approval of Architect prior to installation. The letter size and background color shall conform to the ANSI Scheme for the Identification of Piping Systems.

F. Provide all labels on all vents thru roof.

G. Close attention shall be paid to all vent vent piping including that piping which penetrates roof. - This piping must be identified, including all vent penetration through the roof.

1.23 VALVE TAGS, NAMEPLATES AND CHARTS

A. All valves on pipes of every description shall be provided with neat circular brass valve tags of at least 1 1/2" in diameter, attached with brass hook to each valve stem or handle as determined by Architect. Tags shall be provided by the HVAC Subcontractor for the work under his charge. Stamp on these valve tags, in letters as large as practical, the number of the valve and the service, such as "HW", "HWC", "CW", ", for hot water, hot water circulation, cold water. The numbers of each service shall be consecutive. Obtain approval of Architect prior to installation. All pipe system valves to be tagged.

B. All valves on equipment shall be numbered by 3" red metal discs with 2" high white numbers secured to stem of valves by means of brass hooks or small link brass chain.

C. These numbers shall correspond to numbers indicated for valves on the Record Drawings and on (2) printed detailed lists. These printed lists shall state the numbers and locations of each valve and the equipment or system which it controls and other necessary information such as requiring the opening or closing of another valve or valves when any one valve is to be opened and closed.

D. These printed lists shall be prepared in form to meet approval of the Architect and shall be framed under glass. Provide valve lists in booklet form also and submit (6) copies to the Architect.

E. Nameplates, catalog numbers and rating identification shall be securely attached to mechanical equipment with screws or rivets. Adhesives or cements will not be permitted.

F. The HVAC Subcontractor shall provide for his work all valve charts including his name and telephone number; date of chart; name and telephone number of Architectural Firm and Consulting Mechanical Engineering Firm and the Owner's representative.

G. This information must be submitted on electronic file format also.

1.24 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

A. The HVAC Subcontractor shall thoroughly instruct the Owner's operating personnel, to the complete satisfaction of the Architect, in the proper operation of all systems and equipment provided by him. The HVAC Subcontractor shall make arrangements, via the Other Work Contractor, as to whom the instructions are to be given in the operation of the basic and auxiliary systems and the periods of time in which they are to be given. The Architect and Owner shall be completely satisfied that the Owner's representative has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by the HVAC Subcontractor to the Owner's representative, then the HVAC Subcontractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this paragraph of the specification has been complied with. All time required for Owner's instruction to satisfy the above requirements shall be included in this Contract. No extra compensation for such instructions will be allowed.

B. The HVAC Subcontractor shall submit to the Architect for approval, a total of (6) typed sets, bound neatly in 3-ring loose-leaf binders, of all instructions for the installation, operation, care and maintenance of all equipment and systems. Information shall indicate possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each section such as valves, water boosters, pure water systems, etc., shall be clearly divided from the other sections. A sub-index for each section shall also be provided. The methodology of setting-up the manuals shall be submitted to the Architect and Owner through the Contractor for approval prior to final submission of manuals.

C. The instructions shall contain information deemed necessary by the Architect and shall include, but not be limited, to the following:

1. Instructional classes on equipment and systems operation for Owner's representative and maintenance personnel, by engineering staff of HVAC Subcontractor. Minimum of ten (10) hours of instruction. Instruction shall include:

   a. Explanation of manual and its use.
   b. Summary description of the HVAC systems.
   c. Purpose of systems.

   All training classes and equipment instruction shall be videotaped on VHS format by the HVAC Subcontractor. Provide (3) copies of all tapes to the Owner and one to the Architect. At the Owner's discretion, the HVAC Subcontractor provide ten (10) additional hours of instructions up to one year after the building has been occupied.

2. System

   a. Detailed description of all systems.
   b. Illustrations, schematics, block diagrams, catalog cuts and other exhibits.

3. Operations

   a. Complete detailed, step-by-step, sequential description of all phases of operation for all portions of the systems, including start-up, shutdown, adjusting and balancing. Include all posted instruction charts.

4. Maintenance

   a. Parts list and part numbers.
   b. Maintenance, lubrication and replacement charts and Contractor's recommendations for preventive maintenance, as applicable to his work.
   c. Troubleshooting charts for systems and components.
   d. Instructions for testing each type of part.
   e. Recommended list of on-hand spare parts.
   f. Complete calibration instructions for all parts and entire systems.
   g. Instruction for charging, filling, draining and purging, as applicable.
   h. General or miscellaneous maintenance notes.

5. Manufacturer's Literature

   a. Complete listing for all parts.
   b. Names, addresses and telephone numbers.
   c. Care and operation.
   d. All and only pertinent brochures, illustrations, drawings, cuts, bulletins, technical data, certified performance charts and other literature with the model actually furnished to be clearly and conspicuously identified.
   e. Internal wiring diagrams and engineering data sheets for all items and/or equipment furnished under each Contract.
   f. Guarantee and warranty data.

6. The HVAC Subcontractor shall furnish instructions for lubricating each piece of equipment installed by him. Instructions shall state type of lubricant, where and how frequently lubrication is required. Frame instructions under glass and hang in a location as directed by Architect.

7. Information must be submitted on electronic file also

1.25 MANUFACTURER'S REPRESENTATIVE

A. The HVAC Subcontractor shall provide, at appropriate time or as directed by the Architect, the on-site services of a competent factory trained Engineer or authorized representative of particular manufacturer of equipment such as for the domestic water booster pump, ejectors, hot water heater, pumps, etc., provided under this Contract, to instruct the Owner, inspect, adjust and place in proper operating condition any item provided by him, as applicable. A minimum, system start-up shall start 90 days prior to scheduled building occupancy or at construction managers discretion.

B. The HVAC Subcontractor, as applicable, shall start-up and set in operating condition all major equipment and systems, such as the domestic water booster pump, water heaters, ejectors, well water pumps, etc., in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. In no case will major systems and equipment be activated by any of the Subcontractor's, without the assistance or presence of the equipment manufacturer representative.

C. A written report shall be issued by the particular equipment manufacturer and the HVAC Subcontractor summarizing the results of the commissioning and performance of each system for the Architect's record. No additional compensation will be allowed for any Contractor for such services.

1.26 CONNECTIONS TO EQUIPMENT

A. The HVAC Subcontractor shall provide all pipe connections to equipment provided under other Sections of the specifications as shown on the Architectural Planning, and/or HVAC drawings and herein specified (sterilizers, autoclaves, ice machines etc.), including final connections to equipment, to result in a complete system, fully operational. The HVAC Subcontractor shall also make connections to Owner furnished or relocated equipment as specified above. Coordinate location of all equipment with Architect and Other Work Contractor. Obtain installation diagrams and methods of installation of all equipment, from manufacturers. Follow instructions strictly. If additional information is required, obtain same from Architect.

1.27 COORDINATION DRAWINGS

A. Before materials are purchased, fabricated or work is begun, each Subcontractor shall prepare coordination drawings for all floors/areas, including buried systems/services (all-Trade-composite at 3/8 inch scale), showing the size and location of his equipment and lines, in the manner described herein under General Requirements - Section 01040.

B. Coordination drawings are for the architect’s use during construction and shall not be construed as shop drawings or as replacing and shop drawings. The coordination drawings, when corrected for actual “as-built” conditions, will be reviewed by the Architect, corrected and become the Record Drawings to be submitted to the Owner for his use.

C. The cost of producing and reproducing the drawings will be included under the Contract of each Trade, including the cost or preparation of the Architectural building outlines. The Contractor shall take the lead to produce the Architectural backgrounds, show all ductwork, piping, etc., and circulate the drawings to any of his Subcontractors and the other Trades (HVAC, Fire Protection, Electrical), so that they can indicate all their work as directed by the Architect as required, to result in a fully coordinated installation.

D. In addition to the regular coordination drawing review, the HVAC work will also be reviewed by the Architect/Engineer to ensure that the system and equipment arrangements are suitable to provide maintenance access and service as follows:

1. Valves and instrumentation should be grouped where possible and positioned in accessible locations.

D.Prepare a complete set of computer based AutoCad 2005 drawings at scale not less than 3/8" equals 1'-0", showing basic layout for the structure and other information as needed for preparation of Coordination Drawings. The drawings shall indicate the layout of all specialty tradework as indicated herein and shall be designated as Coordination Drawings. The Contractors can purchase a copy of the floor plans on disk from the engineer to assist in the preparation of Coordination Drawings. The Contractor shall provide a minimum of two (2) weeks notice to the engineer for the preparation of the disk. A signed liability release form will be required from the Contractor prior to the release of the disk from the engineer.

F. Highlight all fire rated partitions on the Coordination Drawings for appropriate coordination.

G. The main paths for the installation or removal of equipment from mechanical and electrical rooms shall be clearly indicated on the Coordination Drawings.

H. Each of the specialty trades shall add its work to the base drawings with appropriate elevations and grid dimensions. Specialty trade information shall be required for mechanical rooms, horizontal exits from HVAC closets, crossovers and for spaces in the above ceilings where congestion of work may occur such as corridors and, where required, entire floors. Drawings shall indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions and other services. Indicate elevations relative to finish floor for bottom of ductwork and piping and conduit 6" greater in diameter.

1. Specialty Trade shall include:

a. HVAC system.
b. piping and equipment
c. Electrical
d. Sheet Metal Work
e. Sprinkler System
f. ATC system
g. Medical gas/vacuum

I. Upon completing their portion of the Coordination Drawings, each specialty trade shall sign, date and return Coordination Drawings to the Contractor.

J. Where conflicts occur with placement of materials of various trades, the General Contractor shall be responsible to coordinate the available space to accommodate all trades. Any resulting

adjustments shall be initialized and dated by the affected specialty trade subcontractor. The General Contractor shall then final date and sign each drawing.

K. Fabrication shall not start until Coordinate Drawings have been distributed to all parties as indicated herein.

L. Format: Coordination Drawings (plans only) shall be done using CAD in AutoCAD 2005 in either IBM or Mac Format, disks shall be given tot he architect for future transfer to Owner. Coordination Drawings will be used as base for as-built drawings.

M. Distribution of Coordination Drawings:

1. The General Contractor shall provide one print of each Coordination Drawing to:

    a. Each specialty trade Subcontractor.
    b. Owner
    c. Construction Manager
    d. Architect (for record purposes).

N. After distribution:

1. The method used to resolve interferences not previously identified shall be as in paragraph F. above. Distribute revised Coordination Drawings to all parties listed above.

O. Coordination Drawings include but are not necessarily limited to:

1. Structure
2. Partition/room layout, including indication of smoke and fire resistance rated partitions.
3. Ceiling layout and heights
4. Light fixtures.
5. Access Panels
6. Sheet metal, heating cols, boxes, grilles, diffusers, etc.
7. All heating piping and valves.
8. Smoke and fire dampers.
9. Soil, waste, vent piping, and conductor
10. All water systems.
11. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit. Motor control centers, starters and disconnects.
12. Sprinkler piping and heads.
13. All equipment, including items in the Contract as well as O.F.C.I. and O.F.I. items.
14. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur indicates areas in which the required access area may be greater than the suspected grid systems.
15. Medical Gas Systems

1.28 RECORD DRAWINGS

A. The HVAC Subcontractor shall maintain current at the site a set of his drawings on which he shall accurately show the actual installation of all work provided under his Contract indicating any variation from the Contract Drawings, in accordance with the General Conditions and Supplementary General Conditions. Changes whether resulting from formal change orders or other instructions issued by the Architect shall be recorded. Include changes in sizes, location and dimensions of piping, equipment, etc.

B. Utilizing the coordination drawings described herein before, the HVAC Subcontractor shall modify/correct/edit the HVAC work on the above CAD coordination drawings, to obtain a "CAD" set of Record Drawings. Also include (2) blackline prints, and CDX CAD files of entire record drawings..

C. A marked-up and colored-up set of prints on-site will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner's representatives and they shall be corrected if found either inaccurate or incomplete. This procedure is mandatory.

D. Coordination drawings are for the Contractor's, Architects and Owner's use during construction and shall not be construed as replacing any shop drawings. The CAD coordination drawings, when corrected for actual "as-built" conditions, will be reviewed by the Architect, corrected and will be used to formulate the Record Drawings to be submitted to the Owner for his use.

E. The HVAC Subcontractor shall submit a set of CAD files on disc marked "AS-BUILTS". All costs associated with the production and reproduction of the CAD files shall be included under the HVAC bid for work under the HVAC contracts.

1.29 ELECTRICAL ROOM REQUIREMENTS

A. The HVAC Subcontractor shall not install any piping or equipment in or through electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms, unless piping or equipment is intended to serve these rooms. If the HVAC Subcontractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.

B. Where piping carrying liquid or gas is routed to within 12" of any electrical panels or packaged equipment controllers, the HVAC Subcontractor shall provide galvanized sheet metal drain pans below such piping. The drain pans shall be constructed of minimum 18 gauge G-90 galvanized sheet metal with all joints sealed watertight. Extend 1 1/4" copper drain piping, with dielectric union to nearest floor drain.

1.30 HOISTING EQUIPMENT AND MACHINERY

A. All hoisting equipment and machinery required for the proper and expeditious prosecution and progress of the work under this Contract shall be furnished, installed, operated and maintained in safe condition by the HVAC Subcontractor for his material and/or equipment delivered to the designated hoisting area. All costs for hoisting operating services shall be borne by the HVAC Subcontractor, for all equipment and work under his charge.

1.31 STAGING

A. All staging, exterior and interior for HVAC work shall be furnished and erected by the HVAC Subcontractor and maintained in safe condition by him for proper execution of his work.

1.32 SUBMITTALS

A. Prepare and submit shop drawings in accordance with the requirements hereinbefore specified, and of Division 0 and applicable parts of Division 1 and in the manner described therein, modified as noted hereinafter.

B. All shop drawings shall have clearly marked the appropriate specification number, drawing designation, project name, etc., for identification of the submittal.

C. Disposition of shop drawings shall not relieve the HVAC Subcontractor from the responsibility for deviations from the drawings or specifications, unless he has submitted in writing a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Architect, nor shall such disposition of shop drawings relieve the HVAC Subcontractor from responsibility for error in shop drawings or schedules.

D. HVAC contractor shall provide all submittals and shop drawings as noted in the HVAC specifications and receive approvals before ordering equipment.

E. HVAC contractor scope shall include all ATC work, whether done directly or by a separate entity sub contracted by the HVAC contractor. This scope includes providing all submittals, shop drawings, schematics, sequences, equipment cuts, etc. This scope includes integrating the HVAC equipment with the ATC system for a fully functional system and commissioning all as a working package.

F. HVAC contractor scope shall include all air and water balancing, whether done directly or by a separate entity sub contracted by the HVAC contractor. The test, adjust and balancing shall include all certifications and requirements noted in the specifications and such certifications shall be provided as a submittal along with all other HVAC submittals and shop drawings.

G. Shop drawing data shall include, but not be limited to, the following:

1. Manufacturer's model and catalog data.
2. Complete connection diagrams for all Trades.
3. Dimensions, capacities, ratings, materials, finishes, etc.

H. Each shop drawing is required to bear the review stamp of each Contractor associated with installing the equipment and/or processing the document.

I. Shop drawings shall include, but shall not be limited to, the following:

1. HVAC work layout, including location and sizes of piping, valves, drains, and all other accessories.
2. Equipment Cuts For:

    a. Valves, gauges, piping
    b. Hangers, supports, insulation, and identification.

c. Access panel
d. HVAC circulation pumps.
e. Insulation
f. Seismic bracing
j. Piping
k. Heat tracing
m. HVAC equipments

1.33 TOILET

A. Toilet Exhaust are constant.

1.34 CROSS AND INTERCONNECTIONS

A. No HVAC equipment, device or piping shall be installed which will provide a cross or interconnection between a distributing supply or return system.

1.35 CORE DRILLING

A. This subcontractor shall perform all core drilling required for the proper installation of the HVAC system. Locate all required openings and prior to coring coordinate the opening with the General Contractor. All other openings are by the General Contractor.

B. All core drilling locations must be approved by the Owner.

1.36 COMMISSIONING OF HVAC SYSTEMS

A. Commissioning of systems to be provided by authorized commissioning agent and not this sub-contractor. Commissioning of systems to be as directed by owner. Commissioning of selected systems shall be provided by and secured by owner. Refer to Section 18000 of General Specifications.

B. The HVAC Contractor shall provide 3 days (8 hrs) per each system to assist the commissioning agent in their procedures.
1.Refer to Commissioning Section 18000 in General Specification.

2 PART 2-PRODUCTS

2.1 MATERIALS

A. All materials, except as otherwise specified, shall be new, of current production, first quality and the best of each class specified.

B. Required materials not covered by detailed specifications shall be of a suitable class, grade, quality and type and shall be subject to the approval of the Architect. Where two or more units of the same class of equipment are required, these units shall be the products of a single manufacturer.

C. All equipment shall be installed and constructed to operate safely, as designed, without leakage, undue wear, noise, vibration or corrosion.

D. All products used in this project installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's Representative in writing. Spare parts shall be available for at least five years after completion of this contract.

2.2 ELECTRIC MOTORS AND RELAYS

A. Design, type and ratings of electric motors shall comply with the National Electrical Code, NEMA and Underwriter's Laboratory.

B. Unless otherwise noted or required for special applications, motors shall be open drip-proof with sealed ball bearings.

C. All electric motors shall be of the voltage, type and frame as specified in the electrical portion of the specifications.

2.3 ACROSS-THE-LINE STARTERS

A. All motor starters shall be across-the-line start with magnetic contactors and thermal overloads properly sized for the motor nameplate data.

B. All motor starters shall be furnished with a Hand-Off-Auto (HOA) switch mounted on the cover of the enclosure.

C. All motor starters shall be furnished with a fused 120 volt control power transformer rated at a minimum of 2 amps.

D. All motor starters shall be furnished mounted in a NEMA 1 enclosure suitable for the mounting location.

E. All motor starters shall be provided with magnetic contactors having one normally open and one normally closed auxiliary contactor.

2.4 SEISMIC BRACING

A. The HVAC Subcontractor shall provide all necessary design and materials for seismic restraint and protection of piping, Duct work and devices against damage where subject to earthquakes as required for the entire HVAC system within the building. All isolation and seismic devices shall be the product of a single manufacturer. Products of other manufacturers are acceptable provided their systems strictly comply with this section of the specifications. Provide isolation materials and seismic restraints complete and as manufactured by Mason Industries, Tolco or approved equal.

The work under this section shall include the design, furnishing and installation of all restraint devices and systems as may be required for the HVAC system including, but not necessarily limited to, the following:

1. All HVAC equipment and devices such as Roof top units, Boilers, pumps, air handlers, VAV Boxes, tanks, etc.
2. All HVAC system piping as required.
3. All HVAC system ducting as required.
3. Piping and duct penetrations through floors and walls.
4. Sleeves with clearances around the outside, as recommended.
5. Equipment isolation bases.
6. Piping and duct flexible connectors.
7. Seismic restraints for isolated equipment.
8. Seismic restraints for non-isolated equipment.
9. Certification of seismic restraint designs.

B. Submit ten (7) copies of descriptive data for all products and materials, including the following:

1. Catalog cuts and data sheets for the specific isolators, restraints and all other items to be utilized.
2. Details of methods of sleeving, HVAC, smokeproofing and isolation for pipes and ducts penetrating walls and slabs.
3. Specific details of seismic restraints and anchors, including number, size and locations for each piece of equipment.
4. Calculations to support seismic restraint designs.
5. All calculations, details and other submittal materials shall be sealed and signed by a structural or civil engineer registered in the state and qualified to perform seismic design calculations.
6. A seismic design liability insurance certificate that must accompany all submittals.

C. Code and standards requirements shall include, but not be limited to:

1. Applicable IBC with any additional State or Local requirements.
2. All State and Local codes.

D. Manufacturers working in this section must provide a seismic design liability insurance certificate and certify their ability to provide engineering and design as required by this section. This certificate shall be submitted to the Architect for review prior to any submittals.

2.5 HANGERS AND SUPPORTS

A. Pipe hanger or stanchion support assemblies shall include turnbuckles or other means of vertical adjustment.

B. Trapeze hangers may be used in lieu of separate hangers for closely spaced, parallel lines. Pipe hanger components shall be as per MSS SP-58.

C. Hangers shall have steel rods with two nuts and shall be suspended from suitable beam clamps or concrete inserts. Rod sizes shall be as recommended by the hanger manufacturer and at least the following:

1. Pipe to 2" .....3/8" diameter
2. 2½" - 3".....1/2" diameter
3. 4- 5" .....5/8" diameter

D. Maximum hanger or stanchion support spacing for copper or steel pipe shall be as follows:

PIPE SIZE	MAX SPACING	PIPE SIZE	MAX SPACING	PIPE SIZE	MAX SPACING
3/4” or less	5 feet	2 ½"	9 feet	6"	14 feet
1”	6 feet	3"	10 feet	8"	16 feet
1¼"	7 feet	3 ½"	11 feet	10"	18 feet
1½"	8 feet	4"	12 feet	12"	19 feet
2”	8 feet	5"	13 feet	14"	25 feet

E. Hangers or stanchion supports for copper tubing shall be copper plated where they contact the copper tubing.

F.Hangers or stanchion supports for insulated pipe shall have insulation shields.

G. All rigid piping attached to the building and serving equipment subject to vibration shall be hung or supported on vibration isolators for the first 20 feet.

H. Vertical rises shall be supported from stands at the bottom of the rise or hangers at the top of the rise as shown on the drawings per the Contractor's option.

2.6 ANCHORS

A. Anchor points as shown on the drawings or as required shall be located and constructed to permit the piping system to take up its expansion and contraction freely in opposite directions away from the anchored points.

1. Make proper provision for expansion and contraction in all parts of hot water and steam piping systems wherever possible by means of pipe bends, pipe offsets, swing connections or changes in direction of piping.

B. Where piping network cannot be employed to absorb expansion and contraction in the piping systems, provide expansion joint compensators. Use of expansion compensators in non-accessible locations shall not be permitted.

1. All mains and risers having expansion offsets or compensators shall be securely anchored to the building construction in such a manner as to throw all expansion towards the offsets or joints. The HVAC Contractor shall be responsible for any additional structural members that may be required for proper installation of hangers, anchors, guides and supports.

2.7 VIBRATION ISOLATORS

A. Double deflection neoprene mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Boltholes shall be provided for these areas where bolting is required.

B. Spring type isolators shall be free standing and laterally stable without any housing and complete with ½" neoprene acoustical friction pads between the baseboard and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 80% of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections, compressed spring height and solid spring height.

C. Vibration hangers for piping and mechanical equipment shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bussing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through an arc of 30° before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing showing the 30° swing capability. For locations requiring precise elevation during installation the hanger shall be precompressed to the rated deflection and the released after completion of the installation.

D. Vibration hangers for duct systems shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through an arc of 30° before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing showing the 30° swing capability.

E. Horizontal thrust restraints shall be provided on equipment subject to excessive displacement. The horizontal thrust restraint shall consist of a spring element in series with a neoprene pad. The spring element shall be contained within a steel frame and designed so that it can be preset for thrust and adjusted to allow for a maximum of ¼" movement when the equipment starts or stops. The assembly shall be furnished with one rod and angle brackets for attachment to the equipment and the ductwork. Horizontal thrust restraints shall be attached at the centerline of the thrust and symmetrically on each side of the unit.

2.8 PIPING INSULATION MATERIALS

A. Insulation for pipe shall be glass fiber with a K factor of .24 at 100° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket with a factory applied double pressure sensitive adhesive sealing system.

B. Insulation for concealed fittings and valves shall be glass fiber blanket with a K factor of .24 at 75° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket.

C. Exposed fittings, valves and flanges shall be insulated with molded fitting covers or fabricated segments of pipe insulation.

D. Insulation, jacket and sealant shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less per UL 723.

E. Insulation shall be Owens-Corning Fiberglass ASJ/SSL-II or approved equal.

F. All refrigerant piping (suction and liquid lines) shall be insulated with flexible foamed plastic, minimum 5.0 lb. Per cubic foot density, thermal conductivity not greater the 0.28 Btu-in/sq ft/°F/hour at mean temperature difference of 75°F.

G. All outdoor exposed refrigerant piping shall be painted with two coats of WB Armaflex finish. Prior to applying the finish, the insulation shall be wiped clean with denatured alcohol. The finish shall not be tinted. All seams shall be located on the lower half of the pipe.

H. Insulation thickness shall be as follows:

SYSTEM	PIPE SIZE	THICKNESS
Heating/Cooling Water	½"-1½"	1"
Heating/Cooling Water	2"-4"	1½"
Heating/Cooling Water	> 4"	2"
Make-up Water	all	1"
Refrigerant	all	1½"

2.9 HYDRONIC PIPING

A. Hot water system piping shall be as follows:

	2” and SMALLER	2½" and LARGER
Construction	Solder joint construction with screwed or flanged connections to valves and equipment as required.	Grooved end connection with flanged connections to equipment as required.
Pipe	Type "L" hard temper copper tubing	Carbon steel, Schedule 40 to 8"; ASTM A-120 up to and including 4" ASTM A-53 grade A B for pipe 5" and larger.
Fittings	Cast bronze or cast or wrought copper fittings with 95-5 solder.	Carbon Steel schedule to match pipe.
Couplings	Same as fittings	Same as fittings.
Unions	Same as fittings	

2.10 VALVES

A. All valves shall be first quality of an approved manufacturer, shall be installed with the proper clearances and shall be tight at the specified pressures.

1. Valves shall be of minimum working pressure and materials as fittings specified for the service, however, in no case shall valves be designed for less than 125 PSI working pressure.
2. Where a specific manufacturer, brand and/or figure number is specified, an equivalent figure from an approved manufacturer shall be acceptable.
3. For shut off service the Contractor shall have the option of using gate valves, butterfly valves or ball valves with full open ID.
4. For throttling or modulating service the Contractor shall use a butterfly valve or another type of valve if a specific valve is specified on the drawings.

B. Butterfly Valves

1. Butterfly valves shall be of the flangeless type and may be lug or wafer style if not specified on the drawings.
2. Butterfly valves shall be rated 200 PSI bi-directional, differential pressure with a 200 PSI dead end service rating.
3. Butterfly valves shall have bodies of shock resistant ductile iron and shall have extended necks for 2" of insulation.
4. Butterfly valves shall have no exposed fasteners in the waterway to pin the disc to the stem.
5. Liners shall be molded in and supported by the valve body at the flange seals.
6. Top and bottom stem bushings of dissimilar material are required with a positive retention mechanism
7. Butterfly valves shall be NIBCO figure W/LD 2000.
8. Butterfly valves larger than 4" shall be provided with gear operators.

C. Check Valves

1. Check valves shall be bronze 2." and smaller; Cast iron or cast steel with bronze trim for 3" and larger.
2. All check valves shall have removable caps and regrindable disc and seat ring.
3. Bronze check valves shall be rated 125 PSI SWP, 200 PSI WOG as NIBCO figure T-413 or S-413.
4. Iron Check valves shall be 125 PSI SWP, 200 PSI WOG as NIBCO figure F-918.

D. Globe Valves

1. Globe valves shall be bronze 2½" and smaller; Iron with iron trim for 3" and larger as NIBCO figure T-211 or S-211.
2. Bronze globe valves shall be rated 125 PSI SWP, 200 PSI WOG
3. Iron globe valves shall be OS&Y 125 PSI SWP, 200 PSI WOG as NIBCO figure F-718-N.
4. All globe valves shall be suitable for repacking under pressure.

E. Ball Valves.

1. Ball valves shall be bronze 2½" and smaller as Pittsburgh Brass Manufacturing (PBM) Code B and shall be rated for 200 PSI @ 250^{O}F.
2. Ball valves shall be provided with self draining balls to drain to downstream side.

F.Gate

G. Valve Handles and Operators.

1. Butterfly valves shall be provided with locking lever type hand operators notched to allow incremental positioning and with a positional lock to function as a memory stop. The lock shall be lockable via a padlock.
2. Gate valves shall be provided with handwheels.

2.11 VALVE TAGS

A. Valve Tags shall be a minimum of 2" in diameter, constructed of No. 18 gauge aluminum with stamped numbers and letters filled in with black paint, fastened to valve by heavy aluminum or brass hooks or chain and shall be a different pattern than those used by plumbing and fire protection.

2.12 STRAINERS

A. Strainers shall be installed at the inlet connections to each pump, make-up water connection, water regulating valve and vent, to protect the functionality of all automatic apparatus.

1. Strainers shall be Mueller or approved equal.

B. Strainers shall be line size, Y-pattern and set in the horizontal or vertical downward orientation.

1. Strainers shall be bronze rated 225 PSI at 150.F, 2½" smaller. Bronze strainers shall be Mueller model 351.
2. Cast iron rated ANSI 125# for 3" and larger. Cast iron strainers shall be Mueller model 751.

C. Provide valved dirt blow off connections for each strainer with a valve located 6" to 1'-0" below strainer. Nipples and valves for dirt blow off connections to be full size of strainer blow off tapping. Valves shall have hose bibb connections angled down and shall be provided with a chained cap.

2.13 PIPE EXPANSION COMPENSATION DEVICES

A. Piping shall be installed with expansion loops, expansion couplings, offsets or elbows to accommodate expansion and/or contraction. Where such accommodations are not possible or at the Contractor's option an expansion compensation device may be used.

2.14 SLEEVES

A. Provide Schedule 40 galvanized steel pipe sleeves for each pipe passing through a wall, floor, partition or roof.

2.15 PRESSURE GAUGES

A. Pressure gauges shall be 4½" diameter dial, stainless steel case and ring phosphor bronze bourdon type, 1 percent full scale accuracy with bottom connection. Each gauge shall be provided with an isolation cock and pulsation snubber.

1. Gauges at pump inlets and outlets shall have a red setpoint indicator.
2. Gauge ranges shall be 0-100 PSIG or 10-50 PSIG as appropriate for the system and location.

2.16 THERMOMETERS

A. Thermometers shall be industrial type with 9 inch scale, red perma-colored liquid, black scale divisions on white background, union hub, separable brass well and adjustable swivel base. Extension wells shall be provided on insulated lines.

1. Thermometer ranges shall be 50-250°F for the heating water system and 0-100ºF for the cooling water system.

2.17 FLEXIBLE CONNECTORS

A. Flexible connectors shall be as manufactured by Mason Industries Model MFTNC twin sphere neoprene connectors.

2.18 RELIEF VALVES

A. Relief valves shall be constructed with iron bodies and all bronze working parts. They shall be set for the pressures indicated on the drawings or as required by the system and built to comply with the requirements of ASME.

2.19 AUTOMATIC AIR ELIMINATION ASSEMBLY

A. The air separator shall be a tangential inlet and outlet type separator. The air shall be vented to atmosphere via an automatic float activated vent valve located in the top of the air separator. The air elimination system shall be constructed of cast iron or welded steel; constructed and tested in accordance with Section VIII of the ASME code for a working pressure of 150 psi.

1. Vent valves shall be piped with a 3/8” copper tubing to the nearest floor drain.

2.20 PURGE/BALANCE VALVES

A. Purge valves shall be all bronze construction with a ½" drain tapping. Purge valves shall be installed as shown on the drawings and as required to completely purge all branches of the piping systems.

2.21 DUCT INSULATION MATERIALS - DUCT WRAP

A. Insulation for ducts and fittings shall be glass fiber with a K factor of .25 at 75° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket with a 2" stapling flange.

1. Insulation, jacket and sealant shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less per UL 723.
2. Insulation shall be Owens-Corning Fiberglass Type 150 or approved equal.

2.22 WEATHERPROOFING OF OUTDOOR INSULATION MATERIALS

A. Finish outdoor attic insulated piping with .016" thick aluminum jacket with Benjamin Foster 30-45 Foam Seal.

B. Finish fittings and valves with mitered sections of the insulation with factory attached aluminum jackets.

2.23 FILTERS

A. Unless otherwise noted filters in fan coil units and HRVs shall be 2” 30-30 filters.

B. See section 2.62 for RTU Filters.

2.24 RECTANGULAR DUCTS

A. All ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

2.25 ROUND DUCTS

A. All ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

2.26 FLEXIBLE DUCTS

A. All flexible ducts shall be made from aluminum sheet, spiral wound into a corrugated tube. No adhesives shall be used in it's construction. Spiral wound flexible ducts will not be acceptable.

B. All flexible ducts must conform to NFPA 90A requirements and be tested in accordance with UL-181 and bear a UL label and be installed in accordance with their listing by UL.

2.27 RECTANGULAR DUCT FITTINGS

A. All ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

2.28 FLEXBLE CONNECTORS

A. All connections between vibrating or rotating equipment and ductwork shall be made with a flexible connection consisting of a heavy fiber glass fabric, double coated with neoprene and shall be fireproof conforming to NFPA 90A, waterproof and airtight. The flexible connection shall be a minimum of 6" long and held in place with heavy metal bands.

2.29 VOLUME DAMPERS

A. Furnish and install, where indicated on the drawings or where required for balancing, air splitter dampers, butterfly dampers, or opposed blade dampers with indicating and locking quadrants or push rods and pillow blocks.

B. Opposed blade dampers shall be manually operated multi-blade type with sleeve bearings, galvanized steel interlocking blades and a galvanized steel frame. In ducts over 19" in depth and 12" in height, use multiple opposed blade type, gang operated dampers with a maximum blade width of 8". Fabricate the damper blades of 10 gauge steel with hemmed edges, and a maximum length of 48". Damper operating rods shall be the full blade length and shall extend through the duct to externally mounted bearing plates. On insulated ductwork, bearing plates shall be flush with insulation finish and fastened to the duct. The operating lever shall be of the indicating type with locking quadrant. Splitter dampers shall be sufficiently long to extend the full width of the branch duct to which they are attached. Where necessary they shall curve to scoop branch duct air out of the main duct airstream. The dampers shall be constructed in accordance with the latest SMACNA standards and shall be at least two gauges heavier than the ducts in which they are installed.

2.30 ACCESS PANELS

A. Hinged access panels shall be provided at locations of volume dampers, and elsewhere as required to service the duct systems. Access doors shall be fully gasketed for air tight seal at the rated working pressures of the systems in which they are installed. Access doors shall be adequately sized for their intended purpose and equipped with a minimum of two sash locks. Access doors in insulated ducts shall be double wall and insulated.

2.31 REGISTERS, GRILLES AND DIFFUSERS

A. The types, sizes and airflow patterns of the registers, grilles and diffusers as specified and as shown on the plans have been selected to accomplish the intent and purpose of the system. Any substitutions proposed for items scheduled, shown or specified must provide the same air flow patterns, at the same air volumes and must have the same acoustical characteristics as the specified elements.

B. All interiors of all ducts in back of all registers, grilles and diffusers shall be painted with one coat of flat black nonflammable paint.

C. Duct connections to supply devices shall be made inside the collars, if any, and, duct connections to return or exhaust devices shall be made outside the collars, if any.

D. All registers, grilles and diffusers shall have a baked enamel, white, semi-gloss finish.

E. Square and rectangular diffusers shall have removable cores with opposed blade dampers, gasketed borders and concealed fastenings.

F. Frame types of diffusers shall be as appropriate for the type of ceiling in which they are to be installed.

G. Supply, return and exhaust air registers shall have opposed blade dampers and gasketed borders.

2.32 THERMOSTATS

A. Thermostats shall be provided where shown on the drawing.

2.33 FIRESTOPPING

A. Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and fired experience.

B. Provide all required accessories including, but are not limited to: Slag-/rock-wool-fire insulation, Fire-rated form board, Temporary forming materials, Substrate primers, Collars and Steel sleeves

2.34 INLINE PUMPS

A. Furnish and install pumps with capacities as shown on plans.

B. The pumps shall be of the horizontal, oil-lubricated type, suitable for 125 pounds working pressure

C. The pumps shall have a ground and polished steel shaft with a hardened integral thrust collar. The shaft shall be supported by two horizontal sleeve bearings designed to circulate oil.

D. The pumps are to be equipped with a mechanical seal with carbon seal face rotating against a ceramic seat. The motor shall be non-overloading at any point on pump curve.

E. The motor shall be of the drip-proof, sleeve-bearing, quiet-operating, rubber mounted construction. Motors shall have built-in thermal overload protectors.

2.35 SHEET METAL WORK

A. All supply, return and exhaust air ductwork of all types shall be constructed of galvanized sheet metal based on the "Pressure Class" indicated in the "Minimum SMACNA Construction Standards" table found hereinafter. Note: In addition, the construction pressure class shall be at least 2" more (negative or positive) than the scheduled fan pressure.

B. In addition to sheet metal ductwork provided under this Contract, furnish and/or install accessories and devices furnished by others, including but not limited to smoke detectors. Provide and install miscellaneous sheet metal work including safing, mixing baffles, and blank off panels at unused louver areas.

C. All duct systems specified to be installed under this Contract, shall conform to the drawings, specifications, Standards, details and recommendations of the latest Edition of SMACNA "HVAC Duct Construction Standards - Metal and Flexible"; and "Round and Industrial Duct Construction Standards" (hereinafter referred to as Duct Manual).

D. Provide volume dampers in all branch takeoffs and in all main branches and ducts of all ductwork systems (supply, return and exhaust) for properly regulating and balancing airflow to all terminal outlets, for all duct sizes, whether shown on the drawings or not. Volume dampers installed in ductwork that is to be externally insulated shall have extended activator/handle rods such that adjustment of the damper handle will not disturb the insulation.

E. Fire Dampers shall be provided as shown on the drawings and wherever Architectural drawings indicate fire and rated partitions.. All dampers shall meet the requirements of NFPA 90A and further shall be tested, rated and labeled in accordance with UL 555, latest edition.

2.36 SOUND ATTENUATORS

A. Provide factory prefabricated sound attenuators of the types and sizes shown on the plans and/or listed in the schedule. Sound attenuators shall be prefabricated standard products of a single responsible manufacturer.

B. Sound attenuators shall be hospital grade type as manufactured by IAC, Vibro-Accoustics or approved equal.

2.37 AIR TERMINAL BOXES (VAV)

Fan Powered Terminals
Series Flow (Constant Volume)
TFS Basic Unit

1. Furnish and install TITUS Model DTFS series flow fan powered terminals of the sizes and capacities shown on the plans. Space limitations shall be reviewed carefully to ensure that all terminals will fit the available space.
2. Terminals should be certified under the ARI Standard 880 Certification Program and carry the ARI Seal. Non-certified terminals may be submitted after testing at an independent testing laboratory under conditions selected by the engineer in full compliance with ARI Standard 880. These tests must be witnessed by the engineering consultant with all costs to be borne by the terminal manufacturer. Testing does not ensure acceptance.
3. The terminal shall be designed, built, and tested as a single unit including motor and fan assembly, primary air damper assembly, water or electric heating coils, and accessories

as shipped. Unit shall ship as a complete assembly requiring no field assembly (including accessories). All electrical components shall be UL listed and installed in accordance with the UL Standard 1995. Electrical connection shall be single point. All electrical components, including low voltage controls, shall be mounted in sheet metal control enclosures. The entire terminal shall be ETL listed as a complete assembly.

4. The terminal casing shall be minimum 20-gauge galvanized steel, internally lined with engineered polymer foam insulation, which complies to UL181 and NFPA 90A. Insulation shall be 1½ pound density, closed cell foam. Exposed fiberglass is not acceptable. The insulation shall be mechanically fastened to the unit casing. The casing shall be designed for hanging by sheet metal brackets.
5. The terminal casing shall have top and bottom access panels, which allows removal of fan assembly and servicing of terminal without disturbing duct connections.
6. ECM Motor
    a. Fan motor assembly shall be forward curved centrifugal fan with a direct drive motor. Motors shall be General Electric ECM variable-speed dc brushless motors specifically designed for use with single phase, 277 volt, 60 hertz electrical input. Motor shall be complete and operated by a single phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commutate the stator. All motors shall be designed for synchronous rotation. Rotor shall be permanent magnet type with near zero rotor losses. Motor shall have built-in soft start and soft speed change ramps. Motor shall be able to be mounted with shaft in horizontal or vertical orientation. Motor shall be permanently lubricated with ball bearings. Motor shall be directly coupled to the blower. Motor shall maintain a minimum of 70 percent efficiency over its entire operating range. Provide a motor that is designed to overcome reverse rotation and not affect life expectancy.
    b. The terminal unit manufacturer shall provide a factory installed PWM controller for either manual or DDC controlled fan cfm adjustment. The manual PWM controller shall be field adjustable with a standard screwdriver. The remote PWM controller shall be capable of receiving a 0-10 Vdc signal from the DDC controller (provided by the controls contractor) to control the fan cfm. When the manual PWM controller is used, the factory shall preset the fan cfms as shown on the schedule.
    c. The primary air damper assembly shall be heavy gauge steel with shaft rotating in Delrin self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking, and a synthetic seal to limit close-off leakage to the maximum values shown in the following table Provide an AeroCross™ four point, center-averaging differential pressure airflow sensor. A sensor that delivers the differential pressure signal from one end of the sensor is not acceptable. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.
    d. The sound levels shall not exceed the octave band sound power levels indicated in the table above. Sound performance shall be ARI certified. If NC is provided instead of octave band sound power data, the radiated and discharge path attenuation function for the specified NC shall be based upon factors found in ARI Standard 885-98, Appendix E. No additional attenuation factors shall be deducted from the sound power.

7. Hot Water Heating Coils
    a. Hot water heating coils shall be enclosed in a minimum 20-gauge galvanized steel casing, with flanged construction for attachment to metal ductwork. Coils shall be factory installed on the terminal. Fins shall be rippled and corrugated heavy gauge aluminum, mechanically bonded to tubes. Tubes shall be copper with minimum wall thickness of 0.016 inch, with male solder header connections. Coils shall be leak tested to 300 psi, with minimum burst pressure of 1800 psi at ambient temperature. Number of coil rows and circuits shall be selected to provide performance as required per the plans. Coil performance data shall be based on tests run in accordance with ARI Standard 410.

A. ESV Basic Unit

1. Furnish and install TITUS Model (P)(A)(D) ESV single duct, variable air volume terminals of the sizes and capacities shown in the plans.
2. Terminals shall be certified under the ARI Standard 880 Certification Program and carry the ARI Seal. Noncertified terminals may be submitted after testing at an independent testing laboratory under conditions selected by the engineering consultant in full compliance with ARI Standard 880. These tests must be witnessed by the engineering consultant with all costs to be borne by the terminal manufacturer. Testing does not ensure acceptance.
3. The terminal casing shall be minimum 22-gauge galvanized steel, internally lined with engineered polymer foam insulation which complies to UL181 and NFPA 90A. Insulation shall be 1½ pound density, closed cell foam. Exposed fiberglass is not acceptable. The insulation shall be mechanically fastened to the unit casing. The casing shall be constructed to hold leakage to the maximum values shown in the Casing Leakage table.
4. The damper shall be heavy gauge steel with shaft rotating in Delrin® self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking and a synthetic seal to limit close-off leakage to the maximum values shown in the Damper Leakage table.
5. Actuators shall be capable of supplying at least 35-inch lbs. of torque to the damper shaft and shall be mounted externally for service access. Terminals with internal actuator mounting or linkage connection must include gasketed access panel, removable without disturbing ductwork. Casing with access panel shall be constructed to hold leakage to the maximum values shown in the Casing Leakage table.
6. At an inlet velocity of 2000 fpm, the minumum static pressure required to operate any terminal size shall not exceed 0.13-inch wg for the basic terminal.
7. Sound ratings for the terminal shall not exceed 30 NC at 1.0” static pressure. Sound performance shall be ARI certified.
8. Accessories - Hot Water Reheat Coils
    a. Hot water reheat coils shall be enclosed in a minimum 20-gauge galvanized steel casing with slip and drive construction for attachment to metal ductwork. Coils shall be factory installed on the terminal discharge. Fins shall be rippled and corrugated heavy gauge aluminum, mechanically bonded to tubes. Tubes shall be copper with minimum wall thickness of 0.016-inch with male solder header connections. Coils shall be leak tested to 300 psi with minimum burst pressure of 1800 psi at ambient temperature. Number of coil rows and circuits shall be selected to provide performance as required per the plans. Coil performance data shall be based on tests run in accordance with ARI Standard 410.

2.38 WATER PUMPS

A. Pumps shall be in line, centrifugal type as indicated with flexible coupling connections of pump to motor, and coupling guard as manufactured by Bell and Gossett, Taco or Thrush. Pumps shall be complete with mechanical seals, standard bronze fittings, and 1750 RMP motors, magnetic starters with "Hand-Off-Auto" selector switches and pilot lights in covers. Pump capacities shall be as indicated on the drawings. All pumps shall be nonoverloading at any point on pump curve.

2.39 FLEXIBLE CONNECTORS

A. Neoprene Flexible Connectors:

1. Furnish and install where indicated on the drawings and at the piping connections to all pumps, chillers, and any other equipment that vibrates, flexible connectors. They shall be constructed of nylon reinforced neoprene with 150 lb flanges. Units shall be rated at 215 psi operating pressure at 240°F.
2. The units shall have a minimum axial compression of 2", transverse movement of 1 1/2", and angular movement of 30°.
3. Connectors shall be Model TF as manufactured by C-Flex or equal equipment by Mason Industries or Armstrong Pump Company.

2.40 UNIT HEATERS

A. Propeller type, arranged for horizontal discharge, complete with suitable efficient air deflectors, hot water coil, direct driven motor and guard. Unit shall be manufactured by Airtherm, Sterling or Modine with capacities and sizes as indicated on the drawings. Unit heaters shall be provided with disconnect switches, mounted on heater casing.

B. Cabinet, centrifugal, multiple type, with arrangements as indicated on the drawings, complete with direct driven motor with intergral overload protection, nonferrous hot water heating coils, and cabinets with colors as selected by Architect. Units shall be as manufactured by Airtherm, Modine or Sterling.

2.41 WATER TREATMENT

A. The HVAC Contractor shall furnish and install where shown on the drawings and where specified hereinafter, the necessary apparatus to provide water treatment and service as furnished by Betz Laboratories, Inc., Barnstead Still and Sterilizer Company, Barclay Chemical, Inc., or as approved.

B. A contract satisfactory in form and substance to the Owner shall be executed between the HVAC Contractor and the Water Treatment Company to furnish supervisory service to assure the use of the proper chemical treatment to and for the systems of a period of one year from the date of the initial treatment thereof.

C. The contract shall be assigned by the HVAC Subcontractor to the Owner on the date that the building is accepted by the Owner so that water treatment will continue uninterrupted during the one year life of the contract. The water treatment company shall perform the following through its agents:
   1. Supervise the initial introduction of water treatment.
   2. Provide service calls by its agents at a frequency of not less than once per thirty (30) days thereafter.
   3. Furnish all required chemicals for proper treatment of all systems hereinafter described together with all necessary testing equipment and reagents for field analysis of the water during the aforementioned one year period.

D. HVAC Subcontractor shall assume responsibility for the field testing and control, regular addition of chemical treatment in whatever amounts are necessary on each of the systems hereinafter described until the date of acceptance of the building by the Owner.

E. Before actual execution of the above contract, a copy of the proposed contract form shall be submitted to the Architect for approval.

F. Hot Water Systems:

   1. Liquid chemical bypass type feeders of approximately 5-gallon capacity, complete with valves and fittings shall be connected across the water pumps.
   1. The water circuits shall be treated with sufficient amounts of the proper chemicals to give a starting concentration of 1,000 ppm of sodium chromate, the concentration not to fall below 550 ppm during operation of any of these systems.
   2. ERV UNIT
      a. Casings: Panels shall be of 18 gauge steel, cleaned, phosphatized and finished inside and out with baked enamel finish. Unit shall be completely insulated with 1" fireproof, permanent, odorless glass fiber material with knockouts provided on both sides of unit for utility and piping connections.
      b. Fans shall be double width, double inlet, forward curved, multi-blade fans, statically and dynamically balanced with fan assemblies rotatable from top to rear. Variable pitch drive shall be provided.
      c. Casings and all accessories, with the exception of coils, shall be given a protective enamel paint finish. Fans and scroll shall be coated with corrosion resistant paint.
      d. Unit shall be complete with gas-fired furnace,. Automatic outside air damper and filters .
      e. ERV shall be complete with remote control unit.
      f. Unit shall be provided with variable drive sized with 50% safety over motor nameplate and shall be complete with magnetic starter with "H-O-A" in cover.

2.42 MOTORS

A. All motors shall be premium efficiency type.

B. Motors 1 HP and greater shall be 208/230 Volt/3 Phase/60 Hertz.

C. All motors shall be rated for inverter duty, and stamped as such.

D. All motors shall have Class F insulation or higher temperatures

E. Motors shall be manufactured by Toshiba, General Electric Co., Baldor or Approved Equal.

2.43 VARIABLE FREQUENCY DRIVES

A. Provide a variable frequency drive (VFD) of capacity, quantity and characteristics as required to meet motors as noted on drawings. VFDs shall comply with the latest applicable standards of ANSI, IEEE and NEMA.

B. As a minimum, the full load output current of the drive shall be equal to the equivalent motor horsepower as listed by NEC Table 430-150.

2.44 ROOF EXHAUST FAN

A. Furnish and install fans with capacities as shown on plans.

B. Roof exhaust fans shall be centrifugal type as scheduled.

C. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances.

D. Wheels shall be statically and dynamically balanced.

E. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. Windbands shall have a rolled bead for added strength and shall be joined to curbcaps with a leakproof, continuously welded seam.

F. Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted on vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.

G. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.

H. Motor pulleys shall be adjustable for final system balancing. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring.

2.45 HYDRONIC PUMPS AND ACCESSORIES

A. Acceptable manufactures: Bell and Gossett. Taco, Armstrong or approved equal.

B. Construction shall permit complete servicing without breaking pipe or motor connections.

C. Pumps to operate at 1750 rpm unless scheduled or specified otherwise.

D. Provide guards around shafts and couplings in accordance with OSHA and ANSI recommendations.

E. All parts shall be suitable for Variable frequency drives; including but not limited to Motor, Pump, all pump components, coupling, and base.

F. Design and performance requirements: Pump curve shall rise continuously from maximum flow to cut off. Shut-off head shall be approximately 20 percent greater than design head, unless Pump brake horsepower not to exceed motor horsepower rating over entire operating range (from shut-off to run-out). Motor shall not operate in service factor. Pumps shall operate within the preferred operation region as defined by the Hydraulics Institute. Select pump for operation at or near peak efficiency. Cavitation-free at all points on curve. Impeller diameter shall not exceed 90 percent of the maximum cutwater diameter. Vibration levels of pump shall be within the vibration limits established by hydraulic institute.

2.46 EXPANSION AND COMPRESSIONS TANKS

A. Tanks shall be the pressurized captive air bladder type, with replaceable elastomeric bladder suitable for a maximum operating temperature of 240°F.

B. Tanks shall be constructed and certified to ASME Section VIII - Pressure rating of 150 psig, Temperature of 240°F

C. Provided with integral steel base ring for vertical mounting, charging valve enclosure, remote air connector coupling, system connection and lifting rings.

D. Tanks shall be provided with factory applied rustproof coat of paint to the exterior of tanks.

E. AIR SEPARATORS - Provide tangential type air separator with flanged inlet and outlet connections and bottom blow down drain connection with valve.

2.47 CHEMICAL WATER TREATMENT

A. The HVAC Contractor shall engage the services of a nationally recognized water treatment manufacturer or local representative of such manufacturer to provide a complete water treatment service, designed to minimize corrosion and scale formation in all water systems. This service shall include providing the equipment, controls, chemical feed pumps, bypass feeders, all chemicals and consulting analysis service for the initial clean out and start-up period of each system.

2.48 TESTING, ADJUSTING, & BALANCING

A. The HVAC Contractor shall procure the services of an independent Balancing and Testing Contractor who specializes in the balancing and testing of heating, ventilating and air conditioning systems to balance and adjust, all moving equipment and air distribution and exhaust systems and test all water systems and equipment, as herein specified. All work by the Balancing Contractor shall be done under direct supervision of a qualified heating and ventilating Engineer employed by the Balancing Contractor.

2.49 ROOFTOP AIR HANDLING UNITS

MILLENNIUM SINGLE PACKAGE ROOFTOP UNITS 30 TONS, Model Series: Z

A. General

1. Rooftop air handling units shall be as manufactured by York manufacturer Inc., or approved equal.
2. Units shall be manufactured by York or equal in an ISO 9001 certified facility. YORK's Millennium package units are convertible single packages with a common footprint cabinet and common roof curb for all 25 through 40 ton models. All units have independent refrigeration circuits and provide up to 4 stages of cooling. These packaged cooling/heating air conditioners are designed for outdoor installation and can be easily installed on a roof curb or slab. All Millennium units are self-contained and assembled on rigid full perimeter base rails with internal lifting lugs for overhead rigging. Every unit is completely charged, wired, piped, and tested at the factory to provide quick and easy field installation. Only utility and duct connections are required at the point of installation. The multi-stage gas fired heaters have aluminized steel tubular heat exchangers and spark to pilot ignition. They are available in natural gas with field conversion to propane.
3. Description: Supply Based on York Millennium packaged rooftop system in accordance with the capacities in the plans. Units shall be rated by the manufacturer at a minimum 10.5 EER according to ARI 360. Units shall be shipped in a single package, fully charged with R-410A refrigerant. The manufacturing facility shall be registered under ISO 9001 Quality Standards for Manufacturing. Units shall carry both ETL and CGA safety approval ratings. Tags and decals to aid in the service or indicate caution areas shall be provided. Installation and maintenance manuals shall be supplied with each unit. Units shall be capable of providing mechanical cooling down to 40°F (0°F with low ambient kit). Unit shall be capable of starting and running at 120°F. Unit electric and gas connections shall be either through the curb or the side of the unit.
4. Construction; The base rail shall be constructed of 12 gauge galvanized steel, extending the full perimeter of the unit. All components shall be supported from the base, and the base shall include integral lifting lugs. The unit base rail shall overhang the roof curb for water runoff and shall have a fabricated recess with a continuous flat surface to seat on the roof curb gasket, providing a positive, weather tight seal between the unit and the curb.
5. Casing; The unit cabinet shall be double wall construction to provide both maximum resistance to bacterial growth in the air stream and superior structural integrity. All sheet metal shall be G90 mill galvanized sheet metal, formed and reinforced to provide a rigid assembly. Sheet metal shall be cleaned in an alkaline and zinc phosphate bath, and the exterior surfaces shall be coated with a 1.5 mil powder paint, capable of withstanding 1000 salt spray hours in accordance with ASTM B-117. The unit shall be insulated with 1-1/2", 1 pound fiberglass insulation between the two sheet metal skins. Insulation shall meet NFPA-90A regulations for smoke and flame spread ratings. The cabinet corner post and the intermediate side supports shall be 16 gauge steel. All access doors shall be 18 gauge on the exterior surfaces, and 20 gauge on the interior. Floor shall be 18 gauge, and 24 gauge. All serviceable sections shall have optional hinged access doors with latches on both sides of the unit. All access doors shall be constructed of 20 gauge steel on the outside, with 24 gauge on the inside. Each door shall seal against a rubber gasket to prevent air and water leakage.

The roof shall be double wall, with 18 gauge on the external surface and 24 gauge on the interior. The roof shall be formed with a 45 degree drip lip overhanging the sidewalls to prevent precipitation drainage from streaming down the side of the unit. Roof sections shall be connected together via integral channels fastened with screws and sealed with rubber gasketing. Each fastened seam shall be further protected by a sheet metal channel covering the full length of the gasket surface, making a completely water tight seal.

6. Unit shall have the approval of one of the following agencies: Underwriters' Laboratories (UL), Electrical Testing Laboratories (ETL) or American Standards Association (ASA). The air handler shall bear an appropriate label certifying that the unit has been designed and manufactured in strict accordance with the UL1995 Standard for air handling equipment. If the manufacturer cannot provide an ETL/UL sticker on the air handler, it will be the sole responsibility of the contractor to arrange for local ETL or UL approval and labeling.
7. The Unit Electrical Panel(s) shall be built in strict accordance to NEC Standards and shall bear an appropriate label certifying compliance with UL Standard 508A.
8. The air handling equipment manufacturer shall provide single source responsibility for all components for the unit whether specifically manufactured by the unit manufacturer or obtained outside and installed in the equipment with the exception of consumable items such as filters, fan belts, etc., or as specifically warranted by the product manufacturer such as motors, VFD's, etc.
9. The attached schedules, tables and specifications are to be used as the selection criteria for the air handling equipment to include Air Flow Rates, External Static Pressures and Water Flow Rates. The following are to be equaled or bettered: Coil Face velocities and Filter Face Velocities. The following are to be met within 5% of specified values: internal air pressure drops, water pressure drops.
10. Additional Testing and Quality Assurance as explained in individual component / item sections in the following paragraphs of this specification.
11. Warranty:
    a. Unit manufacturer to warrant it's product to be free of defects in materials and workmanship under normal use when installed and operated in accordance with factory recommendations for a period of 18 months from date of shipment or 12 months after initial equipment start-up, which ever occurs first. Equipment found to be defective should be replaced or repaired to include all parts and labor. Component parts that require periodic replacement due to normal wear such as filters, fan belts, etc. are not covered by the warranty.

B. Submittals:

1. Submit shop drawings with product data.
2. Shop drawings shall indicate assembly weights, unit dimensions, required clearances, construction details, and field connection details.
3. Product data shall indicate dimensions, weights, capacities, ratings, fan performance to include fan curves, motor electrical characteristics to include motor technical data sheets, coil capacities to include performance printouts with pressure drops (water & air), vibration isolation, filter data sheets to include pressure drops, gauges and finishes.
4. Clearly identify any variations from contract documents.
5. Provide space on cover document for contractor and architect/engineer review stamps.
6. Revise & resubmit submittals as required.
7. Submit installation, start-up and Operation & Maintenance Data.
8. Include instructions for rigging, lifting, bearing lubrication, filter replacement, motor and drive replacement, and wiring diagram.

a. Include a recommended spare parts list customized to each unit complete with appropriate tag #, serial and / or part numbers along with a description to clearly identify the items.

SUPPLY AIR FAN

Fans shall be centrifugal type, statically and dynamically balanced in the factory. Fan wheels shall be designed for continuous operation at the maximum rate of fan speed and motor HP. The fan and motor assembly shall be mounted on a common base to allow consistent belt tension with no relative motion between the fan and motor shafts. The entire assembly shall be isolated from the unit base with rubber isolators or optional 1" or 2" deflection springs. The fan discharge shall be connected to the cabinet through a reinforced neoprene flexible connection to eliminate vibration transmission from the fan to the unit casing. Fans shall be double-width, double-inlet with forward curved blades. Fan wheels shall be of Class I or Class II construction.

OPTIONAL

On variable air volume units without variable frequency drives, fans shall be provided with heavy gauge, corrosion resistant blades, with zinc-plated steel inter-locking operating mechanism. Both inlet vanes must operate from a single shaft and be synchronized for precise control.

Units equipped with variable frequency drive on supply fan must be controlled by a duct static transducer providing a 2-10 VDC signal to the drive. Supply fan variable frequency drives shall have factory option of being equipped with a manual drive bypass.

BEARINGS AND DRIVES

Bearings shall be self-aligning pillow-block re-greasable ball bearings with an average life expectancy of 200,000 hours. Grease fittings shall be accessible through access doors. Fan motors shall be NEMA designed, Standard efficiency (option, Hi-efficiency) ball bearing type with electrical characteristics and horsepower as specified. Motors shall be 1750 RPM, open drip proof type. The motor shall be located within the unit on an adjustable, heavy steel base. All fan motor drives shall be selected for a minimum service factor of 1.2 and have fixed pitched sheaves.

AIR FILTERING SYSTEM

All filter holding frames shall be of heavy duty construction designed for industrial applications. All filters shall be either side accessible or front loading with access doors provided on both sides of the filter section. All filter media shall be Class II listed under UL Standard 900. Filter efficiencies shall be rated in accordance with ASHRAE Standard 52-76 2" Throwaway Filters with fiberglass media multiple shall be standard

OPTIONAL

Two inch pleated, throwaway filters with 30% efficiency. Rigid filters shall be high performance, expanded area, disposable type filters. Rigid filter sections shall be preceded by a 2” throwaway prefilter assembly. Filter efficiency shall be 95% (Option: 65%) based on ASHRAE Standard 52-76.

AIR INLET SYSTEM

General

Outside Air inlet openings shall be covered by a factory installed rain hood permanently attached to the cabinet to prevent windblown precipitation from entering the unit. The rain hoods on the front and back of the unit shall be rotated into the cabinet and secured for shipment so that upon installation they need only be rotated upwards and screwed into place. The outside air hood shall contain a removable and cleanable filter with an efficiency rating of 50% based on ASHRAE 52- 76. All damper assemblies shall be of low leak design. Damper blades shall be fabricated from a minimum of 16 gauge galvanized steel. Blade ends and edges shall be covered with vinyl seals. Damper shafts shall be fabricated from solid steel and mounted in the frame with bronze bearings. On all units not equipped with an economizer, an option shall be available for a manually adjustable outside air damper shall be capable of admitting 0-25% outside air.

Economizer (Optional)

An economizer shall have outdoor air and return air dampers that are interlocked and positioned by fully modulating, solid state damper actuators. The actuators shall be spring loaded so that the outside air damper will close when

power to the unit is interrupted. The operation of the economizer shall be fully integrated into the cooling control system. The economizer shall be available for control via a dry bulb sensor (Optional: single or dual enthalpy sensors).

RELIEF SYSTEM (Optional)

All units with relief must have an economizer.

Barometric Relief (Optional)

Building air exhaust shall be accomplished through barometric relief dampers installed in the return air plenum. The dampers will open relative to the building pressure. The opening pressure shall be adjustable.

Exhaust Air Fans (Optional)

General - forward curved centrifugal fan(s) shall be installed in the return air plenum for positive power exhaust. Fans shall be on a common shaft, driven by a single motor. The fans, motors and drives shall be of the same quality and design as specified for the Supply Air Fan, except the fans shall be Class I. Fans shall be capable of exhausting up to 100% of the nominal CFM of the unit. Non-modulating Exhaust - Units with non-modulating power exhaust shall have a barometric relief damper to prevent outside air from entering in the off cycle. The fans shall cycle on and off with building pressure. Modulating Operation - The fans shall be capable of modulating the amount of air from 0% to 100% of nominal CFM. Modulation shall be through discharge dampers or variable frequency motor speed modulation. Dampers or VFD shall be controlled by static pressure in the conditioned space or return air duct.

ENERGY RECOVERY VENTILATION (FIELD INSTALLED OPTION)

General

The packaged rooftop unit shall have attached at the jobsite a powered exhaust combined with an air intake through a rotating energy recovery wheel, which captures sensible and latent heat from the exhaust air stream and returns it to the incoming air stream. The energy recovery module will be contained in a separate enclosure designed to attach to the end of the Millennium packaged rooftop unit equipped with Simplicity Elite™ control.

The Energy Recovery Ventilation module will be capable of exhausting up to 8,000 (13,000) CFM. Control parameters for the ERV will be preset in the unit control.

HEATING SYSTEM

Gas-fired Heating Section (Optional)

One or more gas-fired heating modules shall be installed to provide the heating requirements per the schedule shown on the plans. The heat exchanger shall be of tubular design. Tubes shall be 2 ¼" OD and constructed of minimum 20 gauge, G160 aluminized steel (1.6 mil aluminum silicone alloy) for corrosion resistance (Optional: 409 Stainless Steel). Flue baffles shall be made of 430 stainless steel. Each gas-fired heat module shall have an induced draft combustion fan with energy efficient intermittent pilot spark ignition and redundant main gas valves with pressure regulator. Units with standing spark ignition shall not be acceptable. An induced draft fan shall be provided to maintain a positive flow of air through each tube, to expel the flue gas and to maintain a negative pressure within the heat exchanger relative to the conditioned space. Induced draft fans shall be direct-drive. One (1) high limit controller per heating module, with automatic reset to prevent the heat exchanger from operating at an excessive temperature will be installed. A centrifugal switch on the induced draft fan motor shaft must be provided to prevent ignition until sufficient air flow is established through the heat exchanger. Secondary airflow safety shall be provided by rollout switch protection. The rollout switch shall discontinue furnace operation if the flue becomes restricted. Units shall ship with an external flue to be shipped in the unit and mounted on the job site. The flue shall discharge products of combustion above the unit, preventing recycling of corrosive combustion gases back through the heat exchanger. Gas heating sections shall be both ETL and CGA approved to both US and Canadian safety standards.

Electric Heating Section

An electric slip-in heater shall be installed within the rooftop unit to provide the heating requirements per the schedule shown on the plans. The electric heater shall be wired in such a manner as to provide two equal steps of capacity (80 and 108 kW) or a single step of capacity (40 kW). The furnace shall be an industrial grade design using an open coil(s) made of the highest grade resistance wire containing 80% nickel and 20% chromium. The resistance

coil(s) shall be adequately supported in the air stream using ceramic bushings in the supporting framework. Terminals of the coil(s) shall be stainless steel with high temperature ceramic bushings. The primary high temperature protection shall be an automatic reset type thermal cut out. Secondary protection shall be an automatic reset type thermal cut out. Secondary protection shall be a replaceable thermal link. The operation of the electric heater shall be an integral part of the roof top control system. Power connection to the strip heater shall be through the single power point connection for the entire unit. Electric heat shall be ETL certified to both US and Canadian safety standards.

Hot Water Heating Coil

The manufacturer shall furnish and factory install a hot water coil in the rooftop units, as described in the following specifications. Water coil capacities and pressure drops shall be certified in accordance with ARI Standard 410. The hot water coil shall have eight fins per inch, 2 tubes per circuit, and 2" inlet and outlet connection. Primary surface shall be 1/2" OD copper tube, staggered in direction of airflow. Tubes shall be mandrel expanded to form fin bond and provide burnished, work-hardened interior surface. Return bends shall be die formed and silver-brazed to tubes. Headers shall be of heavy seamless copper tubing, silver-brazed to tubes. Connections shall be of red brass, with male pipe threads, silver brazed to headers. Connections also have 1/4" FPT drain plug on each connection. Extended surface shall consist of die-formed, continuous, aluminum fins with formed channels, and surface treatment to minimize moisture carry-over. Fins shall have fully drawn collars to accurately space fins, and to form a protective sheath for the primary surface. A structural galvanized steel casing shall protect the coil. Tube sheets on each end shall have drawn collars to support tubes. An intermediate coil support shall be provided. The coil shall be circuited to provide free draining and venting, through one vent and drain. Completed coil, including headers, connections and return bends shall be tested with 325 pounds compressed air under water. Coils shall be designed for operation at 250 psig design working pressure.

REFRIGERATION SYSTEM

Units shall have four independent refrigerant circuits for maximum load-matching capability. Each refrigerant circuit shall be controlled with a balance-port thermal expansion valve for maximum control at low load conditions.

Evaporator Coils

Evaporator coils shall be direct expansion type with intertwined circuiting to assure complete coil face activity during part load operation. Coil tubes shall be 3/8” OD copper, internally enhanced tubes. Fins shall be enhanced aluminum mechanically expanded to bond with the copper tubes. Coil casing shall be fabricated from heavy gauge galvanized steel. All coils shall be pressure tested at a minimum of 450 PSIG. A coated steel or optional stainless steel drain pan shall be provided under the entire length and width of the evaporator coil, including all return bends. The main drain pan shall be sloped a total of ¼” per foot towards the drainage point. Main drain pan shall be easily cleanable in the field. The condensate drain opening shall be flush with the bottom of the drain pan to allow complete drainage. Coils in excess of 48” high shall have an intermediate drain pan, also fabricated of stainless steel extending the entire finned length of the coil to provide better water drainage. Drainage from the intermediate drain pan shall be to the primary drain pan. OPTIONAL: Evaporator coils shall be protected by the Technicoat 10-1 four coat process. Coils shall be dipped in a phenolic coating, which provides substantial resistance to corrosion of aluminum and copper.

Compressors

Units shall have four industrial duty hermetic scroll compressors, independently piped and charged. Compressors shall have an enlarged liquid carrying capacity to withstand rugged operating conditions. Compressor frame shall be cast iron, with cast iron fixed and orbiting scrolls. Each compressor shall feature a solid state protection module, designed to protect the compressor from over temperature and overcurrent conditions. Each compressor shall include the following safety and convenience devices: replaceable suction screen, discharge line check valve, and oil sight glass. Compressors shall be vibration isolated from the unit, and installed in an easily accessible area of the unit.

Condenser Coils

Condenser coils shall have 3/8" seamless copper tubes, arranged in staggered rows, mechanically expanded into aluminum fins. Coils shall be protected from hail damage with a V configuration, with individual flat coils rotated 30 from the vertical plane for each condensing circuit. Condensing coils shall have an integral subcooler for more efficient, stable operation. OPTIONAL: Condenser coils shall be protected by the Technicoat 10-1 four coat process. Coils shall be dipped in a phenolic coating, which provides substantial resistance to corrosion of aluminum and copper.

Condenser Fans and Motors

Condenser fans shall be direct drive, propeller type, discharging vertically. Condenser fan motors shall be 3 phase, totally enclosed air over (TEAO) type, with built in thermal overload protection.

Refrigerant Piping

All interconnecting piping between refrigeration components shall be copper tubing with brazed joints. Each refrigerant circuit shall be equipped with liquid line filter drier, and moisture indicating sight glass. Each circuit shall also have both high and low pressure switches installed on either side of the compressor and include shrader depressors for replacement of the pressure switches without removing charge. All small diameter distributor tubing to the evaporator coil shall be protected by polyurethane sleeves over the length of the tubing to prevent the tubes from copper-to-copper contact during shipment or operation.

Hot Gas Bypass (Optional on CV; standard on VAV)

Unit shall have hot gas bypass factory installed on the lead compressor.

CONTROLS

GENERAL DESCRIPTION

Equipment with Simplicity Elite™ as standard shall be factory run-tested through the control, after the test is complete; there will be no wires to re-connect. All control wiring points shall be tested and verified through communication. The control shall be UL or CSA recognized. The control shall be manufactured in a manufacturing facility that is certified to ISO 9001.

COMPRESSOR CONTROL

The control shall have a five-minute Anti-Short Cycle Delay to prevent excessive compressor cycling. The control shall have a three-minute minimum run time to insure that oil gets returned to the compressor each time it starts. The minimum runtime shall be programmable up to 10 minutes. The control shall monitor the High Pressure switch, the Low Pressure switch, and the Compressor Overloads separately for each refrigeration circuit. The control shall have a 30 second Low Pressure Switch bypass when it starts any compressor.

A hard compressor lockout shall occur if the control detects the same switch trip three times in a two-hour window, which starts when the first trip occurs. On the first and second trips, the control will turn the compressor off and wait five-minutes after the switch re-closes, before restarting the compressor.

The control shall be capable of operating both compressors and the economizer when there is a call for both stages of cooling. The control shall have a means of locking out mechanical compression below a programmable low ambient trip point. This must be done without adding extra components to the unit. The control shall have a means of locking out the mechanical compression when the economizer is operating in free cooling mode without additional components. The control shall have a means of starting the compressor before the indoor Fan comes on when operating with a Thermostat in the AUTO FAN mode.

FAN CONTROL

The control shall have fully adjustable Fan ON and Fan OFF delays for both Heating and Cooling settable at the control or via communication. The control's default Fan OFF delay for Cooling shall be 30 seconds to take advantage of the remaining capacity in the coil after the compressor has been turned off. The control shall lock on the Fan if the high temperature limit trips three times in one hour of operation. The control will have a software programmable Fan Mode Switch for Auto operation or Continuous operation. When the Fan is in the Continuous mode, it will run continuously during the occupied schedule and in the Auto mode when in an unoccupied schedule. The control shall be capable of operating the fan without a G or fan signal from the thermostat.

EQUIPMENT CONTROL FEATURES

The control shall be capable of communicating on the Standard Open protocol, Modbus® RTU. The register data for the Modbus® must be publicly available and open. Monitoring Software shall be provided at no cost. The monitoring software shall have a flashing icon when any unit wired to the computer has an alarm. Clicking the flashing icon shall display the fault code and the details of the fault. The networking setup shall be completed by connecting a three-wire daisy chain cable to each unit, then powering all the units up and pushing a button on each control. There shall not be any dipswitches to configure the network address.

The control shall use a communication driver that is capable of having 64 nodes on the bus before a repeater is needed. The control shall use non-volatile memory to store the last five alarms. There shall be a single button to push to recall these last five alarms. The alarms shall be stored first in last out. The first flash code shall be the last alarm that occurred. There shall be a button press sequence to clear the alarms in non-volatile memory. The control shall have a button to reset compressor lockouts without powering the unit down.

The control shall have a button to clear compressor Anti-Short Cycle Delays. When this button is pressed it will only clear the Anti-Short Cycle Delays for one cycle only and not permanently. The control will be compatible with any BAS (Building Automation System). Any BAS shall be able to control the equipment when wired to the control's Thermostat Terminal Strip. The control shall have loading of at least 25 milliamps on all thermostat inputs for controllers and thermostats that use output TRIACs.

The control shall have a Smoke Detector Shutdown input on the board. The control shall be powered through this input, so when the Smoke Detector trips, the control will shut down the unit immediately. The control will have low voltage protection for the contactors and will not energize a contactor if the voltage is below 19.2 VAC, to insure contactor pull-in. If the control has a compressor contactor energized when the voltage drops, it shall not de-energize the contactor until the voltage drops below 16 VAC, which is the drop out voltage for most contactors. The control shall have a means of low ambient control without adding any additional components. The control shall have a means of cycling the compressor on for 10 minutes and off for 5 minutes to defrost the indoor coil when the outside ambient is below a low ambient switch point without adding additional components.

The control shall have a means of storing compressor run time. This data shall be available through communication. The control shall have the ability to clear this data when a compressor is replaced. The control shall have the ability to store a name of at least 26 characters in length. The control will leave the factory with the serial number of the equipment it is in, stored in non-volatile memory in the Name location. The control shall have the ability to store the model number of the equipment of at least 26 characters in length. The control will leave the factory with the model number of the equipment it is in, stored in non-volatile memory. The control shall have the ability to store the serial number of the equipment of at least 26 characters in length. The control will leave the factory with the serial number of the equipment it is in, stored in non-volatile memory.

The control shall not power the contactors through the thermostat wiring. Dropping voltage over the thermostat wiring causes chattering contactors when the contactors are powered in this manner. The control will operate and monitor up to 3 stages of heat independently. The control shall monitor the Gas Heat operation in the heating mode. It shall monitor the gas valve when there is a call for heating. The control shall alarm when there is a call for heat and no gas valve voltage after 5 minutes. There will only be one control board for this series of units, for both CV and VAV operation.

COMFORT CONTROL FEATURES

- The control will be installed and tested at the factory where the equipment is assembled.
- The control will use a Wall Senor that has a means of overriding the unoccupied mode for a programmable amount of time.
- The Unoccupied Override time will be programmed in minutes up to 4 hours.
- The control will use a Wall Sensor that has a warmer/cooler dial so the occupants can offset the programmed setpoint by a programmed amount between 1 and 5 degrees.
- The control will have a Supply Air Sensor as standard.
- The control will have a Return Air Sensor as standard.
- The control will have an Outside Air Sensor as standard.

- The control will use the Return Air Sensor in place of the Space Sensor if the Space Sensor fails for any reason, the control will have a 365 day Real Time Clock.
- The Real Time Clock will be able to do automatic Daylight Savings Time adjustment.
- The control will have an Occupancy Schedule that allows two different Occupied schedules per day for each of the seven days of the week individually.
- The control will have 20 Holiday Schedules, each capable of 99 days.
- The control's Holiday Schedules will have a start time associated with each schedule.
- The control will control the Economizer directly.
- The control will be capable of operating the Economizer using Dry Bulb, Outside Enthalpy, or Differential Enthalpy.
- When the control is using Enthalpy to control the Economizer, it will also have an Outside Air Temperature enable Setpoint.
- The control will use two setpoints for Supply Air Temperature for the Economizer operation. One will be for a small space cooling demand and one for a large space cooling demand.
- The control will have the ability to do Demand Ventilation using one CO_2 sensor.
- The control will have a programmable maximum Outside Air Damper Position for IAQ operation.
- The control will have the ability to temper the ventilation air during times when heating or cooling is not required.
- The control will have the ability to offset the operating setpoint based on high Humidity in the Space.
- The control will have programmable limits when offsetting the Operating Setpoint to control Humidity.
- The control must be able to lockout Cooling below a programmable Outside Air Temperature Setpoint.
- The control will be able to lockout Heating above a programmable Outside Air Temperature Setpoint.
- The control will have a Space Temperature Alarm.
- The control will have a Supply Air Temperature Alarm for Heating and Cooling. The Alarm temperature will be programmable.
- The Control will be able to do a Pre-Occupancy Purge at a Programmable Time.
- The control will have a hardware Smoke-Purge input.
- The control will have the ability to read a dirty filter switch
- The control will have the capability of reading a Fan proving switch.
- The control will have an intelligent recovery function that will bring the space to the Occupied Setpoint just before or at the beginning of the first Occupied schedule each day. The control will learn and apply the minimum run time required to heat or cool the space to setpoint for the first Occupied period of a day.
- The control will have Software controllable Mode Switches (Heat, Cool, and Fan).
- The control will meter and track Unoccupied Override Time for billing purposes.

OPTIONAL SIMPLICITYLINC™ TRANSLATOR

The unit shall have an optional SimplicityLINC™ translator as an interface between a BACnet® control system and devices that communicate using the Modbus® RTU protocol. The SimplicityLINC™ shall be preconfigured to provide an interface to YORK UPG products equipped with an Intelli-Comfort™ or Simplicity Elite™ controller and allow monitoring and control by a third-party BACnet® Building Automation System (BAS).

2.50 Heat Recovery Ventilators- Indoor

A. General unit shall be completely wired and includes blowers, filters, heat exchange core and control panel.

B. Cabinet shall be constructed of 20 gauge pre-painted galvanized steel (G60) and shall be insulated to prevent exterior condensation. Access door shall be hinged and latched with disconnect switch engaged by door panel. Condensate pans have drain connections.

C. Heat exchange shall be aluminum plate heat exchange core assembly held in place stainless steel frame.

D. Provide washable air filters in exhaust and supply air streams.
E. Unit shall include two, separate centrifugal type blowers with direct drive PSC motors and rubber isolated mountings with multi-speed motor control by autotransformer (120VAC / 60Hz / 1 ph).

F. Controls shall include a Digital BASE MODULE operation with illuminated display board and optional remote devices connect to low voltage (12VAC) terminals.

G. Defrost shall recirculate exhaust air through core with automatic dampers and shall occur at factory (preset 27ºF).

H. Units shall have a factory supplied, adjustable internal dehumidistat.

I. Operating controls shall be as noted on schedule and plans.

J. Warranties shall include a 15 year warranty on heat exchanger core and a two (2) year parts warranty.

K. Accessories shall include:

1. 22 026 Weatherhoods, two provided with ¼” (6 mm) mesh screen
2. 12” sleeve insulating duct collar, 2 required.

2.51 AIR DOORS

A. General

1. Related Sections
   a. Section 06100 - Rough Carpentry and 05410 – Load-Bearing Metal Studs and 04810 – Masonry]: Provide reinforcing wall or blocking as required for attachment of air door.
   b. Section 08100 - Metal Doors and Frames. Coordinate installation of switches.
   c. Section 08170 – Door Hardware: Coordinate with installation of hardware.
   d. Section 09900 – Paints and Coatings: Field applied finishes.
   e. Division 16 – Electrical: Connection of electrical service and controls.
2. References
   a. 220 – Air Curtain Units.
   b. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
   c. NEMA 250 – Enclosures for Electrical Equipment.
   d. UL 507 – Electric Fans.

e. UL 508 – Industrial Control Panels.

3. Submittals
   a. Submit under provisions of Section 01300.
   b. Product Data: Manufacturer's descriptive literature and installation instructions; indicate options specified.
   c. Shop Drawings: Submit if required to show configuration of non-standard units and additional installation instructions not shown in Product Data.
   d. Quality Assurance Submittals: Indicate compliance with QUALITY ASSURANCE.
   e. Closeout Submittals:
      I. Operation and Maintenance Data: Manufacturer's printed instructions for operating and maintaining air doors.
      II. Warranty Documents: Issued and executed by manufacturer.
4. Quality Assurance
   a. Firm shall have produced products providing satisfactory use in similar service for not less than five years.
   b. Products shall be manufactured and assembled in United States of America.
   c. Regulatory Requirements: Products shall comply with applicable Underwriters Laboratory (UL).
   d. Except for inclusion of heating, units shall be tested in accordance with AMCA 220 and licensed to bear AMCA Certified Ratings Seal.
5. Delivery, Storage, And Handling
   a. Store in manufacturer's unopened packaging in dry, heated area prior to installation.
6. Warranty
   a. Manufacturer's Warranty: Supply manufacturer's standard two-year limited warranty for heated units against defects in workmanship and materials.

B. Construction

1. Unit shall be equal to Berner Model In-Ceiling Mount [ICM] and shall be factory assembled units of sufficient structural strength to be supported from ends without intermediate support.
2. Cabinet:
   a. Dimensions: Not to exceed 15-1/2 in. height by 24-1/2 in. deep.
   b. Material - General: Corrosion resistant, mill finish, Aluminum.
   c. Material – Bottom: Corrosion resistant [Aluminum with polyester white on white painted finish] [Stainless Steel] riveted and mechanically fastened construction.
   d. [Fasteners: shall be tamper-resistant type.]
3. Motors: 1/2 hp, 3-speed, sleeve bearings, permanently lubricated and sealed bearings, permanently lubricated and sealed bearings, double extended shafts, continuous duty, with internal thermal-overload protection.
4. Fans: Balanced forward curved type, double inlet, mounted in matched fan scrolls with aerodynamically formed air inlet venturies.
   a. Wheels and housing constructed of galvanized steel.
5. Discharge Nozzle:
   a. Provide uniform velocity across width of air door.
   b. Aperture: 3 1/2 in. slot by width of air door.
   c. Vanes: constructed of airfoil-shaped aluminum extrusions; air-directional vanes adjustable plus or minus 20 degrees to deflect airflow.

6. Air Intake:
   a. Location: Bottom.

b. Screen: Perforated pattern constructed of the same material used in housing.

7. Filters
   a. Air inlet filter re-cleanable polyester fire rated with integral filter bracket.

C. HEATING ELEMENTS shall be hot water coil

1. Certify per ARI 410.
2. Construction shall be 16 gauge galvanized steel casing, 5/8 in. outside diameter copper hot water coil with aluminum fins and seamless copper headers.
3. Leak-test for Hot Water shall be 350 psig dry nitrogen.
4. Coil shall be factory mount on air door intake, protected by perforated metal screen.

D. CONTROLS

1. Switching:
   a. Capacity: 1 1/2hp at 120V/1 and 3 hp at 208V/1.
   b. Automatic Door Switch: Switch automatically activates unit when door opens and deactivates unit when door closes.
   c. Time Delay Relay: Adjustable in field from 0.1 second to 10 hours delay. Set delay for 2 minutes unless otherwise indicated.
   d. Thermostat: Remote mount thermostat, capacity; 22 amps at 125/277 VAC.

E. MOUNTING ACCESSORIES

1. Provide brackets and other mounting accessories as required permitting installation and functioning of air door to meet project conditions of use.
2. Mounting accessories shall be painted, aluminized or equal, steel.
   a. Wall mounting brackets constructed of steel with [white] [beige] painted enamel finish.

F.Installation

1. Verify that door frame and adjacent construction are installed and ready to receive work of this Section.
2. Verify that utilities are in correct location and are of correct capacities for specified products.
3. Install air doors where shown on Drawings and in accordance with hop drawings and manufacturers instructions.
4. Air doors shall be securely installed plumb, level, and as close as practical to top of opening and face of wall.
5. Install switches where indicated.
6. Connection to utilities is specified in RELATED WORK.

G. Cleaning and System Startup

1. Clean prior to commissioning.
2. Repair or repaint damage to finishes on exposed-to-view surfaces.
3. Test and operate air door to be sure that it performs as intended. Adjust discharge nozzles to deflect air outward [unless otherwise required.]

2.52 FAN COIL UNIT (FCU-)

A. System Description

1. Vertical, 4-pipe, room fan coil unit for cabinet floor mounted installation. (42VC and VE are low profile units.)

B. Quality Assurance

1. Unit shall be tested and certified in accordance with ARI Standard 440 and base unit UL certified. (Units with special features may not have UL certification.) Each coil shall be factory tested for leakage at 300 psig air pressure with coil submerged in water. Insulation and adhesive shall meet NFPA-90A requirements for flame spread and smoke generation.

C. Delivery, Storage And Handling

1. Each unit shall be individually packaged from point of manufacture. Unit shall be handled and stored in accordance with the manufacturer's instructions.

D. General:

1. Factory-assembled, vertical, blow-thru type floor mounted fan coil for furred-in or exposed installations. Unit shall be complete with water coil, fan(s), motor(s), drain pan, and all required wiring, piping, controls and special features.

E. Cabinet Models (42VB, VE, VF):

1. Cabinet models shall be coated with an Arctic White baked finish, and include a 1-in. fiberglass throwaway filter.
2. Cabinet models shall be free standing with 2 access doors. A stamped supply-air grille shall be included in the top of the cabinet. (Overall cabinet height shall not exceed 141/2 in. on low profile 42VE unit.)

F. Fans:
1. Direct-driven, double-width fan wheels shall have forward-curved blades and shall be statically and dynamically balanced. Scrolls and fan wheels shall be constructed of galvanized steel.

G. Coils:
1. Standard base unit shall be equipped with 2-row coil (42VC, VE, VG units) for installation in a 2-pipe system. Additional coil depth and circuiting shall be provided for installation in a 4-pipe system as described in the Special Features section. All coils shall have ½ in. copper tubes and aluminum fins spacing; Coil fins are mechanical bonded to tube joints. The copper tubes comply with the ASTM B-75. The fin thickness is 0.0045 in and tube thickness is 0.016 in. All coils are tested with air under water and are suitable for design working pressures of 250 psig at 220 F. Burst tested at 350 psig.

H. Controls and Safeties:
1. Unit shall be furnished with a 3-speed, 4-position fan switch on a wall plate for field mounting on furred-in units. Cabinet units shall be furnished with a factory-installed 3-speed, 4-position fan switch. Internal wiring from motor and valves shall be in flexible metal conduit, terminating in the junction box.

I. Operating Characteristics:

1. A double-circuit coil unit installed with a 4-pipe system shall be capable of providing sequenced heating and cooling.

J. Electrical Requirements:
   1. Standard unit shall operate on 120 v, single-phase, 60 Hz electric power. All internal wiring shall be in flexible conduit.

K. Motor(s):
   1. Fan motor(s) shall be 3-speed, 120 v, single-phase, 60 Hz, permanent split capacitor type with sleeve type bearings and oversized oil reservoirs to ensure lubrication. Motors shall have integral automatic temperature reset for motor protection.

L. Special Features:
   Certain standard features are not applicable when the features designated by * are specified. See your local Carrier Sales Office for amending specifications.

1. Unit coil(s) shall be equipped with automatic air vents.
2. The 42VC,VE units shall be equipped with a 2-row cooling/one-row heating split-circuit coil.
3. Fan motor shall be permanent split-capacitor type, 208, 220, 240, or 277-v, single-phase, 50 or 60 Hz as specified on the equipment schedule.
4. Cleanable filter shall be factory installed in the filter track.
5. Leveling legs shall be factory installed on the unit and permit a maximum adjustment of 3/4 inch.
6. Switch box complete with switch shall be factory installed on the unit.
7. Discharge-air grille with double deflection steel or aluminum construction shall be shipped installed in the unit. (42VB,VF,VE units). Steel grilles shall be painted to match cabinet. Aluminum grilles shall be a natural anodized finish.
8. Factory-installed installation options shall include antimicrobial coated, dual density foil faced fiberglass installation.

2.53 Heat Recovery Ventilators- Exterior

A. General units shall be a packaged static plate enthalpic-energy recovery ventilator as manufactured by RenewAire technology or equal in a cabinet weatherized for outdoor use.

B. Quality Assurance

   1. The energy recovery cores used in these products shall be certified by ARI under its Standard 1060 for Energy Recovery Ventilators. ARI published certifications shall confirm manufacture's published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently ARI Certified will not be accepted.
   2. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA 90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.
   3. Unit shall be listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers.
   4. The RenewAire core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten years from the date of purchase. Balance of Unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two years from the date of purchase.

C. Energy Transfer

1. Shall be capable of transferring both sensible and latent energy between air streams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.

D. Passive Frost Control

1. Energy-transfer element shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional extreme conditions shall not affect the usual function or performance of the element. No condensate drains will be allowed.

E. Continuous Ventilation

1. Unit shall have the capacity to operate continuously without the need for bypass, recirculation, preheaters, or defrost cycles under normal operating conditions.

F. Positive Airstream Separation

1. Water vapor transfer shall be through molecular transport by hydroscopic resin and shall not be accomplished by "porous plate" mechanisms. Exhaust and fresh airstreams shall at all times travel in separate passages, and airstreams shall not mix.
2. Laminar Flow
   Airflow through the energy exchange element shall be laminar, avoiding deposition of particulates on the interior of the energy exchange plate material.

G. Construction

1. Energy-exchange module shall be of fixed-plate cross-flow construction, with no moving parts.
   a. No condensate drain pans or drains shall be allowed and unit shall be capable of operating in winter and summer conditions without generating condensate.
   b. Case shall be constructed of galvanized, 20-gauge steel, with lapped corners, and gasketed, zinc plated screw fasteners.
   c. Unit shall have single-point power connection.
   d. No Speed Control Allowed. External blower speed controls shall not be used.
4. Flange components shall be provided suitable for connection of ductwork.
5. Access door shall provide easy access to blowers, energy transfer elements, and filters. Panel shall be gasketed to provide air-tight seal.
6. Case walls and doors shall be insulated with 1" FSK high-density board insulation, eliminating the possibility of exposing the fresh air to glass fibers.
9. Energy-exchange element shall be protected by 30% efficient 2" nominal pleated, disposable filters.
10. Weatherhoods shall be screened to exclude birds and animals. Inlet weatherhood shall be sized to maintain inlet velocities below 500 fpm, and equipped with rain excluder baffles.
11. Blower motors shall be thermally protected with automatic reset, or supplied with starters.

H. Configuration

1. Unit shall be available from factory with vertical return air and vertical supply air duct connection openings.

I. Options

1. Non-pitched roof curbs shall be available from the factory for use with all configurations of the rooftop series units.
2. Units shall be capable of continuous 24/7 operation in winter and summer and just exhaust during economizer operation through remote, wall mounted switch and through contacts for control by BMS system.

2.54 BUILDING HOT WATER BOILERS AND ACCESSORIES

A. This Section includes gas-fired, condensing cast-iron boilers for heating hot water.

1. Related Sections include the following:
   a. "Breechings, Chimneys, and Stacks" for connections to breechings, chimneys, and stacks.
   b. Sections for control wiring for automatic temperature control.
2. Submittals shall include
   a. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated.
   b. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, and method of field assembly, components, and location and size of each field connection.
   c. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
   d. Source Quality Control Tests and Inspection Reports: Indicate and interpret test results for compliance with performance requirements before shipping.
   e. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
   f. Maintenance Data: Include in the maintenance manuals specified in Division 1. Include parts list, maintenance guide, and wiring diagrams for each boiler.
3. Quality Assurance shall include
   a. ASME Compliance: Boilers shall bear ASME "H" stamp and be National-Board listed.
   b. FM Compliance: Control devices and control sequences according to requirements of FM.
   c. Comply with NFPA 70 for electrical components and installation.
4. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."
5. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents. Installing contractor shall provide one year of warranty parts and labor.
   a. Special Warranty: Submit a written warranty, executed by the contractor for the heat exchanger.
   b. Warranty Period: Manufacturer's standard, but not less than 10 years from date of Substantial Completion on the heat exchanger. Warranty shall be non-prorated

and not limited to thermal shock. Additional 21-year thermal shock warranty on heat exchanger.

B. Boilers shall be CSA design certified as a condensing boiler. Boilers shall be designed for a minimum of 5:1 continuous turn down with constant CO2 over the turndown range. The boiler shall operate with natural gas and have a CSA International certified input rating as noted on the drawings, and a thermal efficiency rating up to 99% at minimum input. The boiler shall be symmetrically air-fuel coupled such that changes in combustion air flow or flue flows affect the BTUH input without affecting combustion quality. The boiler will automatically adjust input for altitude and temperature induced changes in air density. The boiler will use a proven pilot interrupted spark ignition system. The boiler shall use a UL approved flame safeguard ignition control system using UV detection flame sensing. The UV detector shall be air cooled to prevent condensate formation and so designed as to prevent misalignment. The design shall provide for silent burner ignition and operation. The boiler shall be down fired counter flow such that formed condensate always moves toward a cooler zone to prevent re-evaporation. An aluminum corrosion resistant condensate drain designed to prevent pooling and accessible condensate trap shall be provided. In some jurisdictions, a means of neutralizing the condensate Ph levels may be required. Boiler shall be able to vent a horizontal distance of 80 equivalent feet with a vent diameter equivalent to the combustion chamber outlet diameter.

1. Service Access: The boilers shall be provided with access covers for easily accessing all serviceable components. The boilers shall not be manufactured with large enclosures, which are difficult to remove and reinstall. All accesses must seal completely as not to disrupt the sealed combustion process. All components must be accessible and able to adjust with the removal of a single cover or cabinet component.
2. Indicating lights: Each boiler shall include a diagnostic control panel with a full text display indicating the condition of all interlocks and the BTUH input percentage. Access to the controls shall be through a completely removable cover leaving diagnostic panel intact and not disrupted.
3. Manufacturers: Manufacturer shall be a company specializing in manufacturing the products specified in this section with minimum five (5) years experience. Hydrotherm (a Mestek Company) is the basis of design. Listed acceptable manufacturers shall be subject to compliance with requirements. Provide boilers by one of the following:
   a. Aerco Benchmark BMK-2.0
   b. Viessmann Vertomat

C. Components shall include

1. Combustion Chamber: The combustion chamber shall be constructed of cast-iron. It shall be a down-fired design utilizing lightweight refractory around the burner housing.
2. Heat Exchanger: Boilers shall be a cast iron sectional unit designed for pressure firing and shall be constructed and tested for 100 P.S.I water working pressure, in accordance with the A.S.M.E. Section IV Rules for the Construction of Heating Boilers. Individual sections will have been subjected to a hydrostatic pressure test of 250 PSIG at the factory before shipment and they shall be marked, stamped or cast with the A.S.M.E. Code symbol. Boilers with less than 250-psi pressure test will not be acceptable for this project. The sections shall be of a down fired counter flow single-pass design. Water ports will be sealed with graphite port connectors. The sections will be fully machined for metal to metal sealing of the gas side surfaces. The design will provide for equal temperature rise through all sections. The heat exchanger shall be designed to prevent fluid boiling. The iron shall have a minimum thickness of ¼". The heat exchanger

design should have no limitations on temperature rise or restrictions to inlet water temperature and a Cv of 60 (KN-6), 100 (KN-10), and 190 (KN-20).

3. Jackets: Stainless Steel.
4. Gas Burner: The burner shall be metal fiber mesh construction, allowing high turndown of the fuel-air mixture. The burner flame shall burn horizontally and be of the pre-mix type with a forced draft fan. Burner shall fire to provide equal distribution of heat throughout the entire heat exchanger. The burner shall be easily removed for maintenance without the disruption of any other major component of the boiler. A window view port shall be provided for visual inspection of the boiler during firing. The gas distribution components and burner shall be enclosed with a cast-aluminum housing.
5. Ignition components: The ignition hardware shall consist of Alumina ceramic insulated ignition electrodes and UV sensing tube permanently arranged to ensure proper ignition electrode and UV alignment.
6. Rated Capacity: The boiler shall be capable of operating at rated capacity with pressures as low as 2" W.C. at the inlet to the burner pressure regulator.

D. The burner shall be capable of 99% efficiency without exceeding a Nox reading above 11ppm. The burner and gas train shall be provided with the following trim and features:

1. Burner Firing: Full modulation with 5:1 turndown @ Continuous CO2
2. Burner Ignition: Interrupted spark
3. Safety Controls: Energize ignition, limit time for establishing flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, and allow gas valve to open.
4. Flue-Gas Collector: Enclosed combustion chamber with integral combustion-air blower and single venting connection.
5. Gas Train: Manual gas valves (2), main gas valve (solenoid), manual test and check valves, pilot gas pressure regulator, and automatic pilot gas valve. All components to be factory mounted and CSD-1 compliant.
6. Safety Devices: Low gas pressure switch, air-flow switch, and blocked flue detection switch, low water cutoff (manual reset), high temperature manual reset. All safeties to be factory mounted.
7. Individual gas regulator provided by factory, shipped loose for field installation, one per boiler.

E. Controls: The boiler control package shall be a MTI Heat-Net or equivalent, integrated boiler management system. The control system must be integral to each boiler, creating a control network that eliminates the need for a "wall mount" stand-alone boiler system control. Additional stand-alone control panels, independent of a Building Management System (BMS), shall not be allowed to operate the boiler network.

1. The Heat-Net control shall be capable of operating in the following ways:
   a. As a stand-alone boiler control system using the Heat-Net protocol, with one "Master" and multiple "Member" units.
   b. As a boiler network, enabled by a Building Management System (BMS), using the Heat-Net protocol, with one "Master" and multiple "Member" units.
   c. As "Member" boilers to a Building Management System (BMS) with multiple input control methods.
2. A boiler becomes a Master when a resistance type 10K sensor is connected to the J10 "SYS/DHW HEADER" terminals. The sensor shall be auto detected. The Master senses and controls the header/loop temperature utilizing a system setpoint. It uses any boilers it finds "Heat-Net Members" or those defined in the control setup menus to

accomplish this. The "Master" shall also have the option of monitoring Outside Air Temperature "OA" to provide full outdoor air reset functionality. Only one master shall be allowed in the boiler network.

a. When operating as a "Master", the Heat-Net control provides a stand-alone method using a PID algorithm to regulate water temperature. The algorithm allows a single boiler "Master" or multiple "Master + Member" boilers in a network of up to 16 total boilers.
b. The control algorithm is based upon a control band, at the center of which is the setpoint. While below the control band, boilers are staged on and modulated up until the control band is entered. Once in the control band, modulation is used to maintain setpoint. Optimized system efficiency is always accomplished by setting the Modulation Maximum "Mod-Max" setting to exploit each boiler in the network's inverse efficiency curve. The control shall operate so that the maximum number of boilers required, operate at their lowest inputs until all boilers are firing. Once all boilers are firing, the modulation clamp is removed and all boilers are allowed to fire above this clamped percentage up to 100%. This "boiler efficiency" clamp is defaulted to 80% and thus limits all the boilers individual outputs to 80% until the last boiler fires. The 80% default must be field adjustable for varying operating conditions. All boilers modulate up and down together always at the same modulation rate. Boilers are shut down only when the top of the band is breached, or before the top of the band, if the control anticipates that there is a light load. Timers shall also be included in each control in the network to prevent any boiler from short cycling.

3. Additional boilers in the network always default to the role of member. The lack of sensors connected to the J10 terminals "SYS/DHW Header" on each additional boiler shall ensure this.
   a. Each "Member" shall sense its supply outlet water temperature and modulate based on signals from a Building Management System (BMS) or "Master" boiler. When operating as a member, starting, stopping, and firing rate shall also be controlled by the "BMS" or "Master" boiler.
   b. When using the Heat-Net protocol, the system setpoint shall be sent from the "Master", along with the modulation value to control firing rate. It also receives its command to start or stop over the Heat-Net cable. Each "Member" will continuously monitor its supply outlet temperature against its operating limit. If the supply temperature approaches the operating limit temperature (adjustable), the boilers input control rate is limited and its modulation value decreases to minimize short cycling. If the operating limit is exceeded, the boiler shall shut off.

F. Each Heat-Net control in the boiler network shall have the following standard features:

1. Digital Communications Control.
   a. Boiler to Boiler: Heat-Net
   b. Building Management System (BMS) with MODBUS standard protocol and BACNET and LONWORKS as optional protocols.
2. Analog 4:20 and 0-10vdc also supported.
3. Distributed control using Heat-Net protocol for up to 16 total boilers.
4. System/Boiler operating status in English text display.
5. Interlock, Event, and System logging with a time stamp.
6. Advanced PID algorithm optimized for specific boilers (KN-Series).
7. Four dedicated temperature sensor inputs for: Outside Air Temperature, Supply (Outlet) Temperature, Return Temperature (Inlet), and Header Temperature.

8. Automatically detects the optional temperature sensors on start up.
9. Menu driven calibration and setup menus with a bright 4-line Vacuum Fluorescent Display.
10. (8) Dedicated 24vac interlock monitors and 8 dedicated 120vac system monitors used for diagnostics and providing feedback of faults and system status.
11. Multiple boiler pump or motorized boiler valve control modes.
12. Combustion Air Damper control with proof time.
13. Optional USB/RS485 network plug-in to allow firmware updates or custom configurations.
14. Optional BACNET and LONWORKS interface.
15. Alarm contacts.
16. Runtime hours.
17. Outdoor Air Reset with programmable ratio.
18. Time of Day clock to provide up to four (4) night setback temperatures.
19. Failsafe mode when a Building Management System (BMS) is controlling setpoint. If communications is lost, the boiler/system shall run off the Local Setpoint.

G. Boiler Trim Shall Include

1. Safety-Relief Valve: ASME rated, factory set to protect boiler and piping as per schedule/drawings. 100 psi maximum allowable working pressure
2. Gauge: Combination water pressure and temperature shipped factory installed. LCD outlet temperature readout to be an integral part of the front boiler control panel display to allow for consistent easy monitoring of temperatures factory mounted and wired.
3. Burner Controls: Boiler shall be provided with a Honeywell RM7800 series digital flame safe guard with UV rectification. The flame safe guard shall be capable of both pre and post purge cycles.
4. High Limit: Temperature control with manual-reset limits boiler water temperature in series with the operating control. High Limit shall be factory mounted and sense the outlet temperature of the boiler through a dry well.
5. The following standard trim:
   a. Aluminum Condensate Receiver Pan
   b. Low Air Pressure Switch
   c. Blocked Flue Detection Switch
   d. Modulation Control
   e. Temperature/Pressure Gauge
   f. Manual Reset High Limit
   g. Low Gas Pressure Safety Switch
   h. Low Water Cutoff with Manual Reset (CSD-1)
   i. Gas Pressure Regulator to provide 4” Incoming Pressure to Main Gas Valve – Shipped Loose for Field Installation.
   j. Air inlet filter
   k. Supply Outlet Temperature Display
   l. Full Digital Text Display for all Boiler Series of Operation and Failures
   m. Air Inlet Filter
   n. Variable Frequency Drive and Combustion Air Fan with Safety Interlock
   o. Condensate Drain
6. PROVIDE THE FOLLOWING JOB SPECIFIC TRIM AND FEATURES
   a. High Gas Pressure Switch and Valve Proving Switch for IRI Compliant GasTrain
7. Boiler Blower Motor: Blower motor shall be externally mounted for ease of service. There shall be no requirement to remove covers or gas train components to remove the blower motor. The KN-10 Blower shall be .5 HP and FLA not to exceed 8 Amps.

8. Test and inspect boilers according to the ASME Boiler and Pressure Vessel Code, Section IV. Boilers shall be test fired in the factory with a report attached permanently to the exterior cabinet of the boiler for field reference.

H. Installation

1. Examine area to receive boiler for compliance with requirements for installation tolerances and other conditions affecting boiler performance. Do not proceed with installation until unsatisfactory conditions have been corrected.
2. Install boilers level and plumb, according to manufacturer's written instructions and referenced standards.
3. Install gas-fired boilers according to NFPA 54.
4. Support boilers on a minimum 4-inch thick concrete base, 4 inches larger on each side than base of unit.
5. Install electrical devices furnished with boiler, but not specified to be factory mounted.
6. Connect gas piping and individual regulator, full size, to boiler gas-train inlet with union.
7. Connect hot water piping to supply and return boiler tappings with shutoff valve and union or flange at each connection.
8. Install piping from safety-relief valves to nearest floor drain.
9. Connect breeching to boiler outlet, full size of outlet. The boiler shall operate under positive (Category IV) or negative (Category II) stack pressure. Vent material must be listed AL29-4C Stainless Double Wall Stack for condensing appliances.
10. Electrical: Comply with applicable requirements in Division 16 Sections.
    a. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

I. Set Up

1. Manufacturer's Field Service: Engage a factory-authorized service representative to supervise the field assembly of components and installation of boilers, including piping and electrical connections. Report results in writing.
    a. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Boiler shall be commissioned by factory-authorized technician. Contact local representative for factory authorized technician information.
2. Manufacturer’s representative shall supply a factory authorized service technician to start up the boilers.
3. Flush and clean boilers on completion of installation, according to manufacturer's written instructions.
4. After completing boiler installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes including chips, scratches, and abrasions with manufacturer's stainless steel polish.

J. Start Up

1. Engage a factory-authorized service representative to provide startup service. Start up to be performed only after complete boiler room operation is field verified to offer a substantial load, and complete system circulation. One-year warranty shall be handled by factory authorized tech.
2. Verify that installation is as indicated and specified.

a. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16 Sections. Do not proceed with boiler startup until wiring installation is acceptable to equipment Installer.

3. Complete manufacturer's installation and startup checklist and verify the following:
   a. Boiler is level on concrete base.
   b. Flue and chimney are installed without visible damage.
   c. No damage is visible to boiler jacket, refractory, or combustion chamber.
   d. Pressure-reducing valves are checked for correct operation and specified relief pressure. Adjust as required.
   e. Clearances have been provided and piping is flanged for easy removal and servicing.
   f. Heating circuit pipes have been connected to correct ports.
   g. Labels are clearly visible.
   h. Boiler, burner, and flue are clean and free of construction debris.
   i. Pressure and temperature gages are installed.
   j. Control installations are completed.
4. Ensure pumps operate properly.
5. Check operation of gas pressure regulator device on gas train, including venting.
6. Check that fluid-level, flow-switch (optional), and high-temperature interlocks are in place.
7. Start pumps and boilers, and adjust burners to maximum operating efficiency.
   a. Fill out startup checklist and attach copy with Contractor Startup Report.
   b. Check and record performance of factory-provided boiler protection devices and firing sequences.
   c. Check and record performance of boiler fluid-level, flow-switch (optional), and high-temperature interlocks.
   d. Operate boilers as recommended or required by manufacturer.
8. Perform the following tests for maximum and minimum firing rates for modulating burner. Adjust boiler combustion efficiency at maximum and minimum modulation rates. Perform combustion flue gas test at minimum and maximum modulation rate. Measure and record the following:
   a. Differential pressure across air / gas orifice.
   b. Combustion-air temperature at inlet to burner.
   c. Flue-gas temperature at boiler discharge.
   d. Flue-gas carbon dioxide, oxygen, and carbon monoxide concentration.
   e. Flue gas Nox emissions where applicable.
   f. Natural flue draft.
9. Measure and record temperature rise through each boiler.

K. Training

1. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
   a. Operate boiler, including accessories and controls, to demonstrate compliance with requirements.
   b. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
   c. Review data in the maintenance manuals. Refer to Division 1 Section "Contract Closeout."
   d. Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
   e. Schedule training with Owner with at least 7 days' advance notice.

2.55 PIPING, FITTINGS, AND JOINTS

A. Provide all piping, fittings, flanges, unions, bolting, gaskets, welding, threading and soldering for main piping network, branches and connections to equipment.
B. All piping shall be clearly marked with material specification.
C. All pipe and material shall comply with the requirements and recommended practices of ASME B31.9 Building Services Piping Code.
D. Provide drains at low points and vents at high points of all piping systems and between pumps and check valves.
E. Hot water and steam piping shall be Schedule 40 Steel for pipe sizes 2-1/2 and greater; Schedule 40 Copper for sizes 2” or less. Condensate piping shall be Schedule 80 for all sizes. All drain piping shall be Copper.

2.56 AIR VENTING AND DRAINAGE

A. Grade all piping for drainage through equipment or through accessible drain valves so that system can be conveniently freed of water by gravity flow.
B. All high points in closed water piping systems shall be relieved of air through accessible manual vents on the high points of the pipe lines and at the equipment.
C. Vent valves on piping and equipment shall be 1/2" ball valves with chains and caps and with discharge pipes to convenient points for catching discharge.

2.57 THERMOMETERS, GAUGES AND PRESSURE/TEMPERATURE TAPS

A. Provide thermometers and gauges as shown on the drawings, and at inlets and outlets of all air handling unit coils, at pumps, etc. Provide pressure taps and thermometer wells for all in-duct or in-box water coils.

2.58 INSULATION

A. All insulation materials, finishes, coatings, cements, jackets and other insulation accessories shall have minimum composite or individual fire hazard ratings as well as thickness and "C" values conforming to State Building Codes which control building construction materials that may be used on this project. Where specification requirements exceed the Code requirements, the specification shall govern. Insulation shall be as manufacturer by Owens Corning, John Manville, Armstrong or approved equal.

B. Insulation for the various systems and associated equipment shall be composed of materials, which are non-combustible and/or provide a fire resistive system of insulation, which complies with the applicable Code having jurisdiction.

C. Insulation Fire hazard ratings shall not exceed Flame Spread Rating 25, Smoke Developed Rating 50.

D. Hot water piping, low pressure steam and boiler blow-down pipe insulation shall be 1-1/2” for Hot water pipe sizes up to 2” and 2” for pipe sizes greater than 2”. All insulation shall have All-service-jacket facing.

E. Medium and High pressure Steam and Condensate piping insulation shall be 2-1/2” for sizes up to 2” and 3” for sizes graeter than 2”. Interior MPS & LPS shall have a jacket of A finish jacket of H.K. Porterlag Lagging Cloth having a treated weight of 16 oz./sq.yd. Exterior HPS and PC piping shall be double thickness with aluminum jacket. Aluminum jacket shall be 0.020 inch thick conforming to ASTM B-209 with a 3 mil factory applied polykraft moisture barrier.

F. Drain piping, refrigeration and cold water make-up insulation shall be 1".

G. All piping within mechanical room and in exposed areas shall have Cell Co plastic jacket.

H. Supply ductwork shall be 1-1/2" fiber board insulation. Ductwork insulation shall have FSKL facing 0.35 mil aluminum foil reinforced with fiberglass yarn reinforcing scrim and laminated to chemically treated fire resistive Kraft paper having a minimum 35 pound per inch width tensile strength when tested in accordance with ASTM D 828. Longitudinal laps and butt strips shall be a minimum of 3 inches. duct installation, sealing and testing is completed by the Mechanical Contractor Ductwork insulation exposed to weather shall be insulated with 2 inch thick fiber glass rigid board insulation with vapor barrier Exterior insulation shall also be be covered with EPDM roofing material with the joints overlapping minimum of 6 inches. All joints shall be staggered and shall be covered with mastic to ensure a weatherproof system.

2.59 AIRE DISTRIBUTION DEVICES

A. General - Provide diffusers, registers and grilles as shown and scheduled on the drawings and herein specified. Diffusers shall be as manufactured by Tuttle & Bailey, MetalAire or approved equal.

B. All diffusers, grilles and registers shall be equipped with factory mounted opposed blade dampers. All air distribution devices shall be of steel or aluminum construction unless otherwise specified herein or scheduled on the drawings.

C. Ceiling Supply - Ceiling or sidewall supply air diffusers of the above types shall be of the restricted multi-orifice jet induction and air mixing type, consisting of louvered sections with built-in diffusing vanes, as manufactured by Tuttle & Bailey Type RCTC or MetalAire Series 5000 IV.

D. Return and Exhaust - General return/exhaust registers shall be equal to Tuttle & Bailey Model T77D or MetalAire Model RHD. All return and exhaust registers installed in all toilet rooms, locker rooms and showers, and other areas subject to moisture shall be similar to above except constructed of all aluminum , including opposed blade dampers, equal to Tuttle & Bailey Model A77D.

E. Sidewall Adjustable Supply - Sidewall supply registers shall be equal to Tuttle & Bailey Model T547 or MetalAire Model H4004SD,

F. Linear Supply and Return – Linear supply and return diffusers shall be equal to Tuttle & Bailey Model EH or MetalAire Model 2000D.

2.60 FINNED TUBE RADIATION

A. Furnish and install where shown on the plans, finned tube radiation as manufactured by Sterling, Vulcan, Slant-Fin, or approved equal. Ratings shall be IBR approved.

B. Heating element type and capacity shall be as scheduled on plans. The element shall be seamless copper tubing, mechanically expanded to aluminum fins.

C. Brackets and hangers shall be 14 gauge, galvanized steel, channel type. Silent horizontal movement during expansion and contraction shall be provided by 18 gauge element support cradle. Bracket shall interlock with backplate channel and provide full engagement enclosure lock.

D. Full backplate shall be 20 gauge steel with mounting channel and slots for mounting brackets.

E. The enclosure shall be 16 gauge steel of style shown on plans, and shall be (baked primer finish suitable for field painting) (baked enamel finish in color selected by Architect from standard color charts. Submit color charts with shop drawings). Welded male and female slip joints are to be provided for positive engagement and alignment of enclosures. Internal 14 gauge gussets (minimum of two) are to be welded at each end of enclosure.All necessary trim is to be provided for a completely finished job.

F. All covers shall run wall-to-wall or wall-to-end cap, as applicable or as required. Provide access door, or easily removable access section for each control or shut-off valve. Door shall require tool for opening. Dampers shall be provided, when indicated on plans, shall have rolled edges and be knob operated.

G. Zone Valves And Thermostats

1. Valves shall be as manufactured by Erie Valve Company, Honeywell or equal, □", 24 V, with 40 VA transformer for each thermostat.
2. Thermostat shall be 24 V with 50□F to 85□F range and shall be compatible with zone valves.

H. Self-Contained Control Valves

1. Thermostatic heating control valves shall be furnished and installed where shown on the drawings. Sizes of valves shall be to suit the capacity of the heating element indicated.
2. Control valve shall be automatic, self-contained, nonelectric, modulating type as manufactured by Danfoss, Macon, or Taco.
3. The control unit shall consist of one stainless steel bellow, and one beryllium copper bellow, nickel-plated copper sensor, and plastic knob.
4. Valve body available in angle or straightway pattern for hot water or low pressure two pipe steam. The valve body shall be with stainless steel disc, seat, and return spring.

2.61 AUTOMATIC SMOKE AND FIRE DAMPERS

A. H&V Subcontractor shall furnish and install where shown on the plans, combination fire and smoke dampers constructed and tested in accordance with UL 555. Each damper shall possess a 1□ hour fire protection rating and shall contain a UL label. The electric damper motor shall have sufficient torque characteristics to operate the size damper indicated.

1. Damper motors shall be furnished as an integral part of the damper by the manufacturer. Damper motors shall be spring return type that allow dampers to close on power interruption and shall require 120 VAC power to open. Motors shall be completely installed and linked ready to operate the damper. Motors shall be installed inside of the duct systems and shall be removable for service or replacement.
2. Dampers shall be combination fire and smoke dampers capable of being mechanically reset.

3. Units shall be signaled from a smoke detector. The smoke detector and related wiring shall be by the Electrical Contractor. The dampers and motor operator shall be furnished and installed by the H&V Contractor, wired by the Electrical Contractor.
4. Dampers shall be Prefco Products, Inc., Model No. 5030 or similar by Phillips or Ruskin.
5. Installation diagram shall be provided with submittal.

B. Smoke Exhaust Control: (System No. 1)

1. On sensing of smoke by smoke detector (located in corridor and furnished and installed by Electrical Subcontractor), all return air automatic dampers shall close, except on floor of incidence.
2. At same time, the automatic damper in supply air register at floor of incidence shall close to preset maximum position, the remainder being left open. Supply air fan shall continue to operate.
3. The automatic damper in return air duct shall close; outside air damper shall open fully; and damper to smoke exhaust fan shall open. Smoke exhaust fan shall operate.
4. A reset switch (furnished and installed on fire panel by Electrical Subcontractor) shall reset dampers to normal positions and shutoff smoke exhaust control.
5. All of the wiring for this system shall be furnished and installed by the Electrical Subcontractor to provide this sequence of control. The Mechanical Subcontractor shall coordinate with the Electrical Subcontractor.
6. Unit smoke detectors shall shut down unit.
7. Dampers shall be Prefco Products, Inc., Model No. 5030 or similar by Phillips or Ruskin.
8. Installation diagram shall be provided with submittal.

C. Smoke Exhaust Control: (System No. 2)

1. On sensing of smoke by smoke detector (furnished and installed by the Electrical Subcontractor), corridor makeup air unit shall stop.
2. At same time, the automatic damper in exhaust air register at floor of incidence shall open, the reminder being left closed and smoke exhaust fan shall operate.
3. A reset switch (furnished and installed on the fire panel by the Electrical Subcontractor) shall reset dampers to normal positions, shutoff smoke exhaust fan, and start corridor makeup air unit.
4. All of the wiring for this system shall be furnished and installed by the Electrical Subcontractor to provide this sequence of control. The Mechanical Subcontractor shall coordinate with the Electrical Subcontractor.

3 PART 3-EXECUTION

3.1 WORKMANSHIP

A. All work shall be coordinated with the work to be installed by other sections of these specifications.

B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.

C. All duct supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this section.

D. Nameplates, catalog numbers, and rating identifications shall be securely attached to equipment.

E. The work shall be performed in a timely manner so as to cause no delay in the overall job progress. The Contractor shall cooperate with the other trades so that the work is installed in the most beneficial sequence for expeditious project completion.

F. Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

G. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment

H. Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electrical Code (NEC).

I. All wiring shall be verified for its integrity to ensure continuity and freedom from shorts and grounds

J. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.2 CLEANING OF SYSTEMS AND PREMISES

A. Before the systems are tested and balanced, all ducts serving the area under construction shall be cleaned so that no dirt, dust or other foreign matter will be carried through or deposited in the systems or the space served by the duct systems.

B. At all times keep the premises clear of rubbish.

C. Upon completion of the work in an area, remove all debris and rubbish resulting from the execution of this contract, and dispose of same. At anytime should the General Contractor be dissatisfied with the performance of the HVAC Contractor's clean up responsibilities, he may elect after notifying the HVAC Contractor to undertake this operation and to backcharge the HVAC Contractor accordingly.

3.3 HVAC CONTRACTOR'S WARRANTY

A. The HVAC Contractor shall provide a one year warranty against failure of the installed materials for any reason. The warranty shall cover the full costs of parts and labor required to remedy the defect, including, if necessary, replacement at the site, and shall run from the date of the Architect's acceptance of the system. The warranty shall also include provision for field inspection at no charge to the Owner, to verify failure, establish probable cause, and determine corrective action required. The HVAC Contractor shall furnish all service during the first year of operation. Any material that in the opinion of the architect, requires excessive service during the first year of operation shall be considered defective and will be replaced by the HVAC Contractor at no charge to the Owner.

B. The HVAC Contractor shall provide a listing of all manufacturer's commercial warranties provided by those manufacturers on their Materials. The list of these warranties must include the time period of each warranty. One copy each of those warranties shall be submitted with the listing.

C. The HVAC Contractor shall be responsible for warranting the testing, adjusting and balancing work for a period of one year after final date of completion. The HVAC Contractor shall also be responsible for all damage to existing systems as a result of the work performed. All damaged systems shall be repaired or replaced at the option of the Owner at no additional cost to the Owner. All such repair or replacement work shall be done immediately upon finding.

D. Warranty response to any malfunction shall be on a next day, normal working hour basis.

E. Work under warranty shall be performed by fully qualified workmen and/or technicians.

F. All guarantees and warranties required to be provided for the work in this Section shall begin their term on the date of final written acceptance of the entire system by the Owner.

3.4 SUBMITTALS

A. The capacity of each HVAC unit shall be substantiated by computer generated selection data or other detailed selection data provided by the manufacturer, for the specific conditions defined on the drawings. Submit 7 copies for approval.

1. The selection data shall clearly show the entering and leaving fluid conditions, the fluid flow volume and the fluid pressure drop through the unit, the ambient conditions, the heat rejection media entering and leaving conditions, the available external static pressure, the unit total static pressure, the airside pressure drops, the refrigerant and the saturated suction temperature, the required RPM of the unit, the motor horsepower, the motor voltage, the motor efficiency, the motor RPM, the motor type, the fuel efficiency, the fuel consumption rate, the maximum capacity, the part load performance data of the anticipated operation of the system, and the radiated sound ratings at design conditions as may be appropriate for any specific piece of equipment.

B. Contractor shall submit shop drawings indicating the method of supporting all units.

3.5 PERFORMANCE

A. The drawings are diagrammatic and the final arrangement of the work shall suit the existing and field conditions, the characteristics of the materials used and the instructions of the Engineer and/or the Architect.

B. The Contractor shall be responsible for repair of damaged or disturbed existing work or the work of other trades caused by his work, testing of his work or repair to his work.

C. All devices shall be installed in accordance with the manufacturer's recommendations, the Engineer's instructions and so as to provide all required access for cleaning, operation, repair and maintenance.

3.6 START UP

A. All equipment, systems, controls and units shall be started as part of a heating, ventilating and air conditioning system, in accordance with all manufacturers' recommendations.

B. Manufacturer's Representative shall start up the RTU chillers and boilers and all other major equipments.

3.7 RECTANGULAR DUCTS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

B. Sealing

All ductwork shall be sealed in accordance with the following table:

SMACNA SEAL CLASS	SEALING REQUIRED	SMACNA STATIC PRESSURE CONSTRUCTION CLASS
A	All transverse joints All longitudinal seams All duct wall penetrations	4" W.G. and up
B	All transverse joints All longitudinal seams	3" W.G.
C	All transverse joints	2" W.G. and down

1. For the purposes of these specifications sealing shall mean the following:
2. The use of adhesives, gaskets, liquids, mastics, hot melt sealant, pressure sensitive tape or combinations thereof to close openings in the surface of the ductwork and field erected plenums and casings through which air leakage would occur.
3. The requirements to seal apply to both positive and negative pressure modes.
4. Pressure sensitive tape shall only be acceptable for sealing ductwork which operates at a static pressure of ½" or less.
5. Liquid sealant shall only be acceptable for slip joints where metal clearances do not exceed 1/16".

6. Gaskets shall be used for all flanged connections and shall have an adhesive backing to adhere to the flange during assembly of the joint.

C. Reinforcement

1. Unless specified otherwise on the drawings rectangular ductwork shall be constructed and reinforced per the following "Rectangular Duct Reinforcement" tables, where the duct wall thickness, the reinforcement spacing and the rigidity class are specified by duct size and pressure classification. Rigidity class designations are based on the SMACNA standards for "Intermediate Reinforcement" and "Transverse Joint Reinforcement" as published in the SMACNA "HVAC DUCT CONSTRUCTION STANDARDS - Metal and Flexible".
2. Duct sides that are 19" and over and are 20 gauge or less with more than 10 square feet of unbraced panel shall be cross broken or beaded unless they are lined or externally insulated.
3. Fittings shall be reinforced similarly to sections of straight duct. On size change fittings the greater fitting dimension determines the duct gauge. Where fitting curvature or internal members provide equivalent rigidity, such features may be credited as reinforcement.
4. The duct side with the largest dimension shall determine the duct gauge.
5. Holes made in the duct walls for the passage of tie rods shall be of minimum size and shall be sealed in accordance with the required duct seal classification.
6. Where used tie rods shall be evenly spaced in the width of the duct dimension.

D. Transverse Joints

1. Transverse joints shall be selected and used consistent with the static pressure class, sealing requirements and duct support intervals for proper assembly.
2. Where bar or angle stock is incorporated in a joint it shall be secured.
3. Fasteners shall be steel and may be zinc or cadmium coated. They shall not project into duct more than ½".
4. Where bolts or welds are specified other types of fasteners shall not be used.

E. Seams

1. Seams shall be suitably selected for the material and pressure classification of the duct.
2. Seams shall be formed and assembled with proper dimension and proportion for tight and secure fit.

3.8 ROUND DUCTS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

B. Duct Gauge

1. Round ducts shall be constructed of the galvanized steel with duct walls in accordance with "SMACNA" standards.

3.9 FLEXIBLE DUCTS

A. Use

1. All flexible duct used on the supply air system shall be insulated with 1½" thick vinyl jacketed fiberglass insulation.

B. Length

1. The minimum length of flexible duct shall be used.
2. The maximum length of flexible duct in any single duct run shall be four feet.

C. Bends

1. Bends shall be made with not less than one and one half duct diameter centerline radius.
2. Maximum bend shall be 90^{o}.

D. Fastening

1. Secure flexible duct to collar or sleeve by peeling back jacket and insulation at end of flexible duct. Fit duct over collar or sleeve and clamp with ½" wide galvanized steel or stainless steel bands or clamps and matching seals. Pull jacket and insulation back in place and secure with two wraps of pressure sensitive sealing tape. Clamping device shall be two inches back from end of flexible duct. Seal with two wraps of duct tape.

I. Installation

1. Flexible duct is to be installed as straight as possible and as tight as possible.
2. Submittals shall include product data sheets as well as the manufacturer's recommended installation practices.

3.10 SUSPENSION OF DUCTWORK

A. Rigid round and rectangular ducts shall be installed with support systems as required to maintain alignment. Horizontal ducts shall have a support within two feet of each elbow and within four feet of each branch intersection.

B. Strap hangers on rectangular ducts may be used on ducts less than 60" wide if they are secured to the bottom of the duct with an approved fastener and with a minimum 1" tab below the duct, or with no fasteners if the strap is a single continuous loop.

C. Multiple trapeze hangers may be suspended from rod hangers to support ducts directly above and below each other if the rods are sized to support the combined load.

D. Round ducts less than 10" in diameter may be suspended by wire.

E. All hangers and trapezes shall be sized, spaced and selected in accordance with Section IV of SMACNA "HVAC DUCT CONSTRUCTION STANDARDS".

3.11 MISCELLANEOUS DUCT WORK REQUIREMENTS

A. Ductwork connected to intake or discharge louvers shall be painted inside for the first ten feet with bitumastic and pitched to a low point. The low point is to be provided with a 1½" copper drain piped by this trade to a building drain.

B. A gasket type joint shall be used where dissimilar metals are joined.

3.12 RECTANGULAR DUCT FITTINGS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

3.13 ROUND DUCT FITTINGS

A. Elbows larger than 8" shall be five piece welded construction.

B. Branch and take-off fittings shall be conical tee or conical reducing tee fittings.

C. Final connections to the individual terminal supply units shall be by means of flexible duct.

3.14 PIPE HANGERS, SUPPORTS, ANCHORS AND GUIDES

A. Contractor shall submit shop drawings indicating the method of supporting all piping furnished by this trade.

B. The Structural Engineer or Architect must approve the method of hanging before work is commenced.

C. Shop drawings of anchors shall be submitted before work is commenced.

D. Shop drawings of guides shall be submitted before work is commenced.

E. Sleeves of the specified type shall be installed wherever pipe lines penetrate walls, roofs, floors or partitions.

F. Sleeves shall be installed in accordance with the requirements of NFPA and the Massachusetts State Building Code.

3.15 VALVE TAGS

A. Valve tag scheme shall be approved by the Engineer prior to installation in the field and insertion on the record drawings.

B. Contractor shall provide a valve tag chart and clearly label the valve tags on the record drawings. The valve chart shall include but not be limited to: tag #, location, valve type, size, how valve operates (solenoid, modulating, manual).

C. Valve tags shall be securely fastened to the valve handle by heavy aluminum or brass hooks or chain.

3.16 VIBRATION ISOLATION

A. All equipment, piping, etc. shall be mounted on or suspended from approved foundations and supports, as specified herein or as shown on the drawings.

B. Mounting sizes shall be determined by the mounting manufacturer and the mountings shall be installed in accordance with the manufacturer's recommendations. The Contractor shall be responsible for the adequacy of the mountings to provide the minimum isolation efficiency required by these specifications or as specifically noted on the drawings.

C. Suspended centrifugal fans shall be installed on vibration isolation hangers.

3.17 PIPING SYSTEM INSTALLATION AND ASSEMBLY

A. All piping shall be installed at right angles to building surfaces, supports and structures.

B. Pipe welding shall performed by a certified welder with oxy-acetylene or electric arc in accordance with the latest revision of the applicable code, ASME Boiler Construction Code, ASA Code for Pressure Piping, or state and/or local codes which may supersede codes mentioned.

C. Threaded joints shall be made with Teflon tape only applied to male threads and care being taken to insure that the tape does not reach the interior of the pipe. All burrs and/or cuttings shall be removed and the pipe shall be reamed or filed out to not less than the original diameter. Piping shall be kept free from scale and dirt.

D. All pipe shall be straight, true and round without obstructions and with sharp, full cut threads or with ends beveled for welding.

E. Provide drain valves with hose connections at all low points and at the bottoms of all risers to allow for complete drainage of the system.

F. All openings shall be capped or plugged during construction to prevent dirt and/or rubbish from entering the piping.

G. Unions or flanged connections shall be placed wherever necessary to permit easy dismantling of the piping and equipment.

H. Where possible, piping shall be grouped together and supported in a neat and orderly manner.

I. Insulating bushings or dielectric nipples shall be provided between steel piping and copper piping on equipment.

J. Air vents shall be provided where indicated on the drawings and at all high points in the water systems.

K. Pipe must be supported before and after expansion compensation devices.

L. Mount all pressure gauges to be read from the floor.

M. Install pressure gauges on the suction and discharge of pumps.

N. Provide two spare pressure gauges of each pressure range and type.

O. Mount all thermometers to be read from the floor.

P. Install thermometers on the supply and return of the chill water system.

Q. Provide two spare thermometers of each range and type.

3.18 FLUSHING OUT TREATMENT

A. After completion of the installation of the piping system and prior to the start up of the systems, the system shall be flushed out with chemicals.

B. The flush out compound shall be trisodium phosphate, three percent by weight.

C. Flush out recirculation shall be for a period of not less than 48 hours.

D. Tests shall be performed following the chemical flushing out and a report shall be issued in writing to the Architect, stating that the cleaning and flushing has been completed satisfactorily.

E. Allowable chemical concentrations after flushing out shall be phosphate - zero, alkalinity - 100 parts per million maximum, suspended solids - zero.

3.19 DUCT INSULATION - DUCT WRAP

A. All work shall be in strict accordance with applicable codes and ordinances and the manufacturers recommendations.

B. All completed work shall be smooth in appearance.

C. Seams shall be stapled 6" on center with outward clinching staples and sealed with pressure sensitive aluminum foil tape.

D. All seams, joints punctures and tears shall be sealed with pressure sensitive aluminum, foil tape.

E. All make-up air ductwork, air conditioning supply ductwork, and ductwork connected to SF-1 shall be insulated. All exterior insulated ductwork shall be weather proofed per Section 2.7.

3.20 BALANCING DAMPERS

A. All branch ducts, balancing dampers shall be located as shown on the drawings or any place requiring one, in the following locations as a minimum: shall have a balancing damper.

1. All supply and return air branches from the trunks and all sub-branches from the mains shall have balancing dampers.
2. Branch duct connections from low pressure ducts to diffusers shall be made with dampered spin collars.

B. Locate dampers as far as possible from air outlets.

3.21 FINAL ACCEPTANCE

A. The Contractor shall leave all system components in proper working order, such as belt guards in place, access doors closed, doors to electrical switch boxes closed, thermostats restored to specified setting. All recorded data shall represent a true, actually measured, or observed condition. Any abnormal conditions in the mechanical systems or conditions which prevent total system balance, shall be reported to the Architect immediately upon finding. The Contractor shall permanently mark all dampers and other adjustment devices in a manner that will allow the settings to be restored.

B. The Contractor shall verify control system operation as specified, and shall report all system problems and malfunctions. The verification and checkout of the control system shall be accomplished during the heating and cooling cycles of operation for an appropriate period of time to assure control response and overall stability.

C. The Contractor shall verify that all air systems are in compliance with all standards, such as ASHRAE minimum outside air, and all other applicable codes and requirements.

D. All filters shall be replaced by the Contractor before commencing.

E. The Contractor shall make any necessary changes in fan speed, and shall realign all belts when necessary.

3.22 AIR AND WATER BALANCING

A. The HVAC Subcontractor shall employ an independent Balancing subcontractor, acceptable to and approved by the Architect/Engineer, to balance and adjust the air and water systems.

B. Balancing and adjusting shall not begin until all HVAC systems have been installed and are in full working order. Prior to the start of balancing, the following shall be checked:

1. Rotation of all fans and pumps.
2. Dampers are free to open and close
3. Fire and smoke dampers are open.
4. Clean filters are in place.

C. Upon completion of balancing and adjusting of the systems hereinafter specified, submit six (6) copies of the data for review and approval by the Architect/Engineer.

D. The balancing Subcontractor shall be procured early enough in the project to allow for him/her to review the project documents and determine if sufficient components are in place to balance and adjust the systems. The balancing subcontract shall provide a list of any deficient are he/she identifies.

E. Balancing Subcontractor shall provide all testing instruments, manpower, temporally connections and materials needed for balancing and adjusting of the air and water systems. All test instruments should have been calibrated within the last six (6) months. Balancing Subcontractor shall provide verification of calibration upon request.

F. Architect/Engineer and Owner shall be notified a minimum of five (5A) days prior to balancing commencing so that a representative can be available to witness the balancing work. In addition, the Balancing Subcontractor shall (upon completion of the balancing work and report submittal), at the request of the Architect/Engineer or Owner's representative, verify the balancing readings at four (4) locations. The locations shall be chosen by the Architect/Engineer or Owner's representative.

G. All balancing and adjusting of air and water systems shall be done in accordance without the latest edition of the NEBB procedural Standards for Testing, Adjusting and Balancing of Environmental systems or the latest edition of SMACNA's HVAC Systems Testing, Adjusting and Balancing.

H. Balancing of the cooling systems shall be performed in the air conditioning season, heating systems in the heating season.

I. Prior to balancing of the air and water systems, and as [art of the balancing report, the Balancing subcontractor shall prepare ductwork and piping schematics of the systems to be balanced. Schematics shall be similar to those indicated in the NEBB and SMACNA publications previously identified. Piping schematics shall be of similar content to ductwork schematics.

J. Air and Water Balancing Report forms shall be similar to the standard NEBB and SMACNA forms found in the previously identified manuals. The following information shall be provided at minimum (reports for equipment and systems not indicated shall be obtained from the NEBB/SMACNA manuals or prepared by the Balancing Subcontractor. Reports prepared by the Balancing Subcontractor shall be submitted for review and approval prior to final Balancing Report submittal):

    1. Air Apparatus Test Report
        a. Location.
        b. System Number.
        c. Manufacturer.
        d. Airflow, design and actual.
        e. Total CFM.
        f. Total Static pressure.
        g. Discharge Static Pressure.
        h. Suction Static Pressure.
        i. Coil pressure drops (static pressure).
        j. Filter pressure drops.
        k. Motor volts and amps.
        l. Outside Air and Return Air CFM.
        m. Drive data.

2. Coil Test Report
   a. system Number.
   b. Location.
   c. Manufacturer.
   d. Airflow, design and actual.
   e. Entering air temperature (DW/WB), design and actual.
   f. Leaving air temperature (DW/WB), design and actual.
   g. Water flow GPM, design and actual.
   h. Entering water temperature, design and actual.
   i. Leaving water temperature, design and actual.
   j. Waterside pressure drop.
   k. Airside pressure drop.
   a.
3. Fan Test Report
   a. System Number.
   b. Location.
   c. Manufacturer.
   d. Airflow, design and actual.
   e. Total static pressure, design and actual.
   f. Inlet static pressure.
   g. Discharge static pressure.
   h. Motor and Drive data.
   i. Fan RPM.
   j. Voltage and Amperage.

4. Duct Traverse
   a. System zone/branch.
   b. Duct Size.
   c. Area.
   d. Design Velocity.
   e. Design Airflow.
   f. Test Velocity.
   g. Test Airflow.
   h. Duct Static Pressure.
   i. Air temperature.

5. Air Outlet Report
   a. Area Served.
   b. Outlet Number.
   c. Type.
   d. Size.
   e. AK factor.
   f. Velocity, design and actual.
   g. Airflow, design and actual.

6. Pump Test Report
    a. Unit Number.
    b. Manufacturer.
    c. Motor data.
    d. Voltage and amperage data.
    e. Waterflow, design and actual.
    f. Suction Pressure.
    g. Discharge Pressure.
    h. Total Head Pressure

K. The Balancing Subcontractor shall balance and adjust air and water systems to meet design requirements. ± 5%. Balancing shall be accomplished by adjusting dampers, drives, valves, etc. to obtain design requirements.

L. The HVAC subcontractor shall cooperate and make provisions for the Balancing Subcontractor as needed to accommodate the air and water balancing. As part of this Contract, the HVAC Subcontractor shall provide and/or change pulleys, belts, sheaves, valves and dampers, at no additional cost, in order to properly balance the systems to design requirements.

3.23 START UP AND TESTING OF COOLING EQUIPMENT

A. All cooling equipment shall be tested to verify that the equipment operates mechanically and electrically as specified.

B. The Contractor shall verify that all operating and safety controls are correctly adjusted.

C. The Contractor shall verify that the cooling equipment controls are operating properly.

D. Tests shall be made to verify that the capacity control is fully modulating according to the required load, and that all control valves are operating according to the specifications. Tests shall be made at minimum load, 50% load, 100% load and various other loads throughout the modulating cycle.

E. The Contractor shall record the following non-test data:

1. Equipment designation number.
2. Equipment manufacturer.
3. Model number.
4. Serial number.
5. Rated input.
6. Rated output.
7. All other pertinent data.

F. The Contractor shall perform and record the following to meet minimum requirements:

1. Verify proper system operation.
2. Verify that the cooling system controls are operating according to design specifications.
3. All other measurements required for complete system testing.

G. The Contractor shall calculate the system coefficient of performance as measured. All calculations made using the measured data shall be included in the report. In general, the Contractor shall complete all tests necessary for complete cooling system analysis.

3.24 SEQUENCES OF OPERATION

A. Chiller Sequence of Operation

1. With a command to start the chiller, the cooler pump will start. After verifying water flow, the control will monitor the entering and leaving water temperature. At any time that a compressor is not operating, its crankcase heater is active. If the need for mechanical cooling is determined, the control decides which circuit and compressor to start. The compressor will deenergize the crankcase heater as it starts. Compressors will be staged with minimum load control (if equipped and configured) to maintain LWT set point. Shutdown of each circuit under normal conditions occurs in increments, starting with the minimum load control (if equipped) and finishing with the last running compressor. Once minimum load control is disabled, one compressor is shut down. Eight seconds later the next compressor will shut down. The process will continue until all of the compressors are shut down. The EXV will close completely, 1 minute after the last compressor has shut down. There are several abnormal conditions that, if detected, will shut down the circuit immediately. In this case, minimum load control and all compressors are turned off without an 8-second interval between them. The cooler pump will remain ON for 20 seconds after the last compressor has been turned OFF.
2. Dual Chiller Sequence of Operation
3. try to keep the difference in capacity between lead and lag to less than 20%. The master chiller will then be responsible for water loop capacity calculation, and will determine which chiller, the lead or lag, will increase or decrease capacity. When the load reduces, the lag chiller will unload first. To accomplish this, the lead chiller set point is decreased by 4° F (–2.2° C) until the lag chiller unloads. To configure the two chillers for dual chiller operation, the master chiller must have the Control Method variable (Operating Mode→□SLCT→OPER) set to meet the job requirements. The slave chiller must be set to Control Method variable (Operating Mode→□SLCT→OPER) = 2 (CCN Control) and the remote-off-enable switch must be in the enable position. The master chiller and the slave chiller CCN addresses (Configuration→ OPTN→CCNA) must be configured. The master and slave chillers can be addressed from 1 to 239. Each device connected to the network must have its own unique address.
4. Both chillers must have the same CCN Bus Number (Configuration→ OPTN→CCNB). Lead/Lag Chiller Enable must be set for both chillers by configuring Master/Slave Select (Configuration→ RSET→□MSSL) to 1 (Master) for the master chiller. The slave chiller Master/Slave Select must be set to 2 (Slave). The master chiller can be configured to use Lead/Lag Balance (Configuration→□RSET→LLBL) to rotate the lead and lag chillers after a configured number of hours of operation. The Lag Start Delay (Configuration→RSET→LLBD) can be configured. This prevents the Lag chiller from starting until the lead chiller is fully loaded and the delay has elapsed. Operating Modes MODE 1 (MD01) — Startup Delay in Effect

5. Criteria for Mode — Tested when the unit is started. This mode is active when the Minutes Off Time (Configuration→ OPTN→DELY) timer is active. Action Taken — The unit will not start until the timer has expired. Termination — The mode will terminate when the timer expires.
6. Possible Causes — This mode is in effect only due to the Minutes Off Time timer. MODE 2 (MD02) — Second Setpoint in Use Criteria for Mode — Tested when the unit is ON. This mode is active when Cooling Setpoint 2 (Setpoints→ COOL→ CSP.2) or Ice Setpoint (Setpoints→COOL→CSP.3) is in use. While in this mode, the Active Setpoint (Run Status →VIEW→SETP) will show the CSP.2 or CSP.3 value. Action Taken — The unit will operate to the Cooling Setpoint 2 (CSP.2) or Ice Setpoint (CSP.3). Termination — This mode will terminate when the Cooling Setpoint 2 (CSP.2) or Ice Setpoint (CSP.3) is no longer in use.
7. Possible Causes — This mode is in effect only due to programming options. MODE 3 (MD03) — Reset in Effect Criteria for Mode — Tested when the unit is ON. This mode is active when Temperature Reset (Configuration→ RSET→ CRST) is enabled either by CRST=1 (Outside Air Temperature), CRST=2 (Return Water), CRST=3 (4-20 mA Input), or CRST=4 (Space Temperature) and is active. Action Taken — The Active Setpoint (Run With a command to start the chiller, the master chiller determines which chiller will become the lead chiller based on Configuration- →RSET→LLBL and Configuration. The lead chiller is always started first and the lag chiller is held at zero percent capacity by the master chiller forcing the lag demand limit value to 0%. The lead chiller's water pump will be started. The lag chiller's water pump shall be maintained off if Configuration→ RSET→LAGP=0. The internal algorithm of lead chiller will control capacity of the lead chiller. If Lead Pulldown Time (Configuration→ RSET→LPUL) has been configured, the lead chiller will continue to operate alone for that specified time. After the Lead Pulldown Time timer has elapsed, if the lead chiller is fully loaded and either all available compression is on or at the master demand limit value, then the lag start timer (Configuration→ RSET→ LLDY) is initiated. When the pulldown timer and lag start timer have elapsed and the Combined Leaving Chilled Water Temperature is more than 3° F (1.7° C) above the set point, then the lag chiller is started. If the lag chiller's water pump was not started when the machines went into occupied mode, then the lag chiller water pump will be started. The lag chiller will start when the master chiller forcing the lag chiller demand limit value (LAG_LIM) to the master's demand limit value. If lead/lag capacity balance is selected, once the lag chiller has started, the master chiller will Status→ VIEW →SETP) will be modified according to the programmed information and will be displayed as the Control Point (Run Status→ VIEW→CTPT). Termination — This mode will terminate when the Temperature Reset is not modifying the active leaving water set point, so SETP is the same as CTPT. Possible Causes — This mode is in effect only due to programming options

B. Boilers Sequence of Operation:

1. The heating shall be inoperative as long as the outdoor temperature is above the setting on the outdoor thermostat (supplied). When the temperature drops below this setting, (usually 65ºF), the "S" control is energized, the heating boilers and the system circulator are energized. The "S" control shall automatically fire the heating boilers as they are needed to maintain the reset water temperature to the system as dictated by outdoor temperature.
2. When the outdoor temperature reaches 65ºF (adjustable), the circulators and the "S" control is de-energized, leaving only the water heating boilers in operation.
3. The entire hot water boiler installation shall be installed in accordance with manufacturer's installation specifications.
4. The "First-on-first-off" switch on the "S" control shall allow heating models to alternate firing sequence.
5. Boilers shall be as manufactured by Hydrotherm or equal.

3.25 EXAMINATION

A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started

B. The Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started

C. The Contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate — or if any discrepancies occur between the plans and the Contractor's work, and the plans and the work of others — the Contractor shall report these discrepancies to the Engineer and shall obtain written instructions for any changes necessary to accommodate the Contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the Contractor to report such discrepancies shall be made by — and at the expense of — this Contractor.

3.26 PROTECTION

A. The Contractor shall protect all work and material from damage by its work or employees, and shall be liable for all damage thus caused

B. The Contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted. The Contractor shall protect any material that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects

3.27 COORDINATION

A. Site

1. Where the mechanical work will be installed in close proximity to, or will interfere with work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. If the Contractor installs its work before coordinating with other trades, so as to cause any interference with work of other trades, the Contractor shall make the necessary changes in its work to correct the condition without extra charge
2. Coordinate and schedule work with all other work in the same area, or with work which is dependent upon other work, to facilitate mutual progress.

B. Submittals. Refer to the "Submittals" Article in Part 1 of this specification for requirements

C. Test and Balance

1. The Contractor shall furnish all tools necessary to interface to the control system for test and balance purposes
2. The Contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours
3. In addition, the Contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.
4. The tools used during the test and balance process will be returned at the completion of the testing and balancing

D. Life Safety

1. Duct smoke detectors required for air handler shutdown are supplied and installed under Division 16. The Division 16 Contractor shall interlock smoke detectors to air handlers for shutdown as described in Part 3: “Sequences of Operation”.
2. Smoke dampers and actuators required for duct smoke isolation are provided under another Division 15 Section
3. Fire/smoke dampers and actuators required for fire rated walls are provided under another Division 15 Section. Control of these dampers shall be by Division 16.

E. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the Contractor as follows:

1. All communication media and equipment shall be provided as specified in Part 2: “Communication” of this specification.
2. Each supplier of controls product is responsible for the configuration, programming, start-up, and testing of that product to meet the sequences of operation described in this section.
3. The Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this Section and those provided under other sections or divisions of this specification.

3.28 FIELD QUALITY CONTROL

A. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this specification

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship

C. Contractor shall have work inspected by local and/or state/provincial authorities having jurisdiction over the work

3.29 WIRING

A. All control and interlock wiring shall comply with national and local electrical codes and Division 16 of this specification. Where the requirements of this section differ with those in Division 16, the requirements of this section shall take precedence.

B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway per NEC and Division 16 requirement.

C. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)

3.30 ACTUATORS

A. Mount and link control damper actuators per manufacturer's instructions.To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.Provide all mounting hardware and linkages for actuator installation.

B. Electric/Electronic

1. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations
2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.31 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels, shall be labelled at each end within 5 cm [2"] of termination with the DDC address or termination number.

B. Permanently label or code each point/object of field terminal strips to show the instrument or item served.

C. Identify control panels with minimum 1 cm [½”] letters on laminated plastic nameplates.

D. Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.

E. Identify room sensors relating to terminal box or valves with nameplates.

3.32 CONTROLLERS

A. Provide a separate controller for each AHU or other HVAC system.

B. Building Controllers and Advanced Application Controllers shall be selected to provide a minimum of 15% spare I/O point/object capacity for each point/object type found at each location. If input /objects are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point/object used.

1. Future use of spare capacity shall require providing the field device, field wiring, point/object database definition, and custom software. No additional controller boards or point/object modules shall be required to implement use of these spare points

3.33 PROGRAMMING

A. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free for future use.

B. Point/object Naming: System point/object names shall be modular in design, allowing easy operator interface without the use of a written point/object index. Use the following naming convention:

AAABBBCCCDDDEEE where:

AAA is used to designate the location of the point/object within the building such as mechanical room, wing, or level, or the building itself in a multi-building environment.

BBB is used to designate the mechanical system with which the point/object is associated (e.g., A01, HTG, CLG, LTG).

CCC represents the equipment or material referenced (e.g., SAF for supply air fan , EXF for exhaust fan, RAF for return air fan).

D or DD or DDD may be used for clarification or for identification if more than one of CCC exists (e.g., SAF10, EXF121).

EE represents the action or state of the equipment or medium (e.g., T for temperature, RH for humidity, CO for control, S for status, D for damper control, I for current).

C. Software Programming

1. Provide programming for the system and adhere to the sequences of operation provided. The Contractor also shall provide all other system programming necessary for the operation of the system, but not specified in this document. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:
   a. Text-based:
      i. must provide actions for all possible situations
      ii. must be modular and structured
      iii. must be commented
   b. Graphic-based
      i. must provide actions for all possible situations
      ii. must be documented
   c. Parameter-based
      i. must provide actions for all possible situations
      ii. must be documented

D. Operator Interface

1. Standard Graphics. Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point/object information on the graphic displays shall dynamically update. Show on each graphic all input and output points/objects for the system. Also show relevant calculated points/objects such as setpoints
2. Sow terminal equipment information on a “graphic” summary table. Provide dynamic information for each point/object show
3. The Contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all Operator Workstation software and their functions as described in this section. This includes any operating system software, the Operator Workstation database, and any third-party software installation and integration required for successful operation of the operator interface.

3.34 CONTROL SYSTEM CHECKOUT AND TESTING

A. Start-up Testing: All testing listed in this article shall be performed by the Contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Owner's Representative is notified of the system demonstration.

1. The Contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification
2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight
3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers' recommendations
4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct
5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The Contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Contractor shall make any necessary adjustments to valve stem and damper blade travel
6. Verify that the system operation adheres to the Sequences of Operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum Start/Stop routines.
7. Alarms and Interlocks
    a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm
    b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
    c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action

3.35 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration

1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed its own tests
2. The tests described in this section are to be performed in addition to the tests that the Contractor performs as a necessary part of the installation, startup, and debugging process and as specified in the "Control System Checkout and Testing" Article in Part 3 of this specification. The Engineer will be present to observe and review these tests. The Engineer shall be notified at least 10 days in advance of the start of the testing procedures.
3. The demonstration process shall follow that approved in Part 1: "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration
4. The Contractor shall provide at least two persons equipped with two-way communication, and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point/object and system. Any test equipment required to prove the proper operation shall be provided by and operated by the Contractor.
5. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
6. Demonstrate compliance with Part 1: "System Performance
7. Demonstrate compliance with Sequences of Operation through all modes of operation
8. Demonstrate complete operation of Operator Workstation
9. Additionally, the following items shall be demonstrated:

a. DDC Loop Response. The Contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in setpoint, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the setpoint, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.
b. Demand limiting. The Contractor shall supply a trend data output showing the action of the demand-limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting setpoint, and the status of shed-able equipment outputs.
c. Optimum Start/Stop. The Contractor shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas
d. Interface to the building fire alarm system
e. Operational logs for each system that indicate all setpoints, operating points, valve positions, mode, and equipment status shall be submitted to the Architect/Engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.
f. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The Contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

B. Acceptance

1. All tests described in this specification shall have been performed to the satisfaction of both the Engineer and Owner prior to the acceptance of the control system as meeting the requirements of Completion. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Engineer. Such tests shall then be performed as part of the warranty.
2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1: “Submittals.”

3.36 CLEANING

A. The Contractor shall clean up all debris resulting from its activities daily. The Contractor shall remove all cartons, containers, crates, etc., under its control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

C.

B. At the completion of work in any area, the Contractor shall clean all of its work, equipment, etc., keeping it free from dust, dirt, and debris, etc.

C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.37 TRAINING

A. General

1. Provide a minimum of one onsite training class 8 hours in length during the construction period for personnel designated by the owner.
2. Provide two additional training sessions at 6 and 12 months following building's turnover. Each session shall be 8 hrs in length and must be coordinated with the building Owner.

B. Train the designated staff of Owner's Representative and Owner to enable Day-to-day Operators to:

1. Proficiently operate the system.
2. Understand control system architecture and configuration.
3. Understand DDC system components.
4. Understand system operation, including DDC system control and optimizing routines (algorithms).
5. Operate the workstation and peripherals.
6. Log on and off the system.
7. Access graphics, point/object reports, and logs.
8. Adjust and change system setpoints, time schedules, and holiday schedules.
9. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
10. Understand system drawings, and Operation and Maintenance manual.
11. Understand the job layout and location of control components.
12. Access data from DDC controllers and ASC.
13. Operate portable operator's terminals.

C. Train the designated staff of Owner's Representative and Owner to enable Advanced Operators to:

1. Make and change graphics on the workstation
2. Create, delete, and modify alarms, including annunciation and routing of these
3. Create, delete, and modify point/object trend logs, and graph or print these
4. Create, delete, and modify reports
5. Add, remove, and modify system's physical points/objects
6. Create, modify, and delete programming
7. Add panels when required
8. Add Operator Workstation stations
9. Create, delete, and modify system displays — both graphical and otherwise
10. Perform DDC system field checkout procedures
11. Perform DDC controller unit operation and maintenance procedures
12. Perform workstation and peripheral operation and maintenance procedures
13. Perform DDC system diagnostic procedures
14. Configure hardware including PC boards, switches, communication, and I/O points/objects
15. Maintain, calibrate, troubleshoot, diagnose, and repair hardware
16. Adjust, calibrate, and replace system components

D. Train the designated staff of Owner's Representative and Owner to enable System Managers/Administrators to:

1. Maintain software and prepare backups
2. Interface with job-specific, third-party operator software
3. Add new users and understand password security procedures

E. Provide course outline and materials as per "Submittals" Article in Part 1 of this specification. The instructor(s) shall provide one copy of training material per student.

D.

F. The instructor(s) shall be factory-trained instructors experienced in presenting this material.

G. Classroom training shall be done using a network of working controllers representative of the installed hardware.

3.38 EXECUTION

A. Verify that door frame and adjacent construction are installed and ready to receive work of this Section.

B. Verify that utilities are in correct location and are of correct capacities for specified products.

3.39 INSTALLATION

A. Install air doors where shown on Drawings and in accordance with [shop drawings and] manufacturers instructions.

B. Air doors shall be securely installed plumb, level, and as close as practical to top of opening and face of wall.

C. Install switches where indicated.

D. Connection to utilities is specified in RELATED WORK.

3.40 SYSTEM STARTUP

A. Test and operate air door to be sure that it performs as intended. Adjust discharge nozzles to deflect air outward [unless otherwise required.]

4.1 AUTOMATIC TEMPERATURE CONTROL SYSTEM

E. Approved Control System Manufacturer

1. The base bid is based on Johnson Controls or equal. Other manufacturers shall bid subject to meeting all requirements of the specification.

F. COMMUNICATION

1. All control products provided for this project shall comprise a BACnet internetwork. Communication involving control components (i.e., all types of controllers and Operator Workstations) shall conform to ANSI/ASHRAE Standard 135-2001, BACnet.
2. Each BACnet device shall operate on the BACnet Data Link/Physical layer protocol specified for that device as defined in this section.
3. The Contractor shall provide all communication media, connectors, repeaters, bridges, hubs, switches, and routers necessary for the internetwork.
4. All controllers shall have a communication port for connections with the Operator Workstations using the BACnet Data Link or equal Physical layer protocol.
5. A device on the internetwork shall be provided with a 56k-baud modem that will allow for remote Operator Workstation using the BACnet PTP Data Link/ Physical layer protocol. Remote Operator Workstation via this modem shall allow for communication with any and all controllers on this network as described in Paragraph F below.
6. Communication services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:
   a. Connection of an Operator Workstation device to any one controller on the internetwork will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the internetwork.
   b. All database values (e.g., objects, software variables, custom program variables) of any one controller shall be readable by any other controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to an object name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communication services to perform internetwork value passing.
7. The time clocks in all controllers shall be automatically synchronized daily. An operator change to the time clock in any controller shall be automatically broadcast to all controllers on the network.
8. The network shall have the following minimum capacity for future expansion:
   a. Each Building Controller shall have routing capacity for 99 controllers.
   b. The Building Controller network shall have capacity for 1000 Building Controllers.
   c. The system shall have an overall capacity for 12,500 Building Controller, Advanced Application Controller, and Application Specific Controller input/output objects.

SECTION 16000
ELECTRICAL

PART 1.00 – GENERAL

1.01 GENERAL PROVISIONS

A. Applicable provisions of "General Conditions" govern work under this section.
B. The Electrical Contractor shall review all other sections of these Specifications for requirements therein affecting the work of this Section.
C. The Electrical Contractor shall conform to all sections of these Specifications and Drawings.
D. Contractors duties for work specified below shall include compliance with all Codes, Ordinances, Rules, Regulations, Orders and all other requirements of Authorities which bear on performance of work.

1.02 SCOPE OF WORK

A. Furnish all labor, supervision, permits, certificates, materials, equipment, apparatus, accessories, supplies, tools, transportation and services necessary for and incidental to, all electrical work as shown on the Drawings and/or specified hereinafter to the full completion of installation and operation of the electrical system.
B. The principal items of work are as follows;

1. Temporary Service
2. Primary Service and Primary cables
3. Pad mounted transformer
4. Secondary Service
5. Voice / Data Service
6. Grounding
7. Main Service Switchboard
8. Power and lighting panels
9. Lighting fixtures and lamps
10. Lighting Controls
11. Safety switches
12. Feeders to panels
13. Branch circuit wiring
14. Outlet boxes, receptacles, etc.
15. Fire Alarm System
16. Emergency Lighting System
17. Emergency Generator and Automatic Transfer Switches
18. All wiring for heating ventilating equipment, wherever required as indicated on Drawings, except control wiring and motor starters
19. Tel/Data outlets and wiring
20. Access Control
21. Site Lighting
22. Lightning Protection System
23. All other systems, equipment and work hereinafter specified and/or shown on the Contract Drawings.

C. It is the intent of the Specifications and the accompanying Drawings that the systems shall be furnished and installed complete. The Electrical Contractor shall furnish and install all conduit, wire, boxes, equipment, devices and controls needed and usually furnished in connection with such work, whether specifically mentioned or not.
D. The Specifications and the accompanying Drawings are complimentary to one another and if a conflict arises between the specifications and drawings and/or within the drawings themselves the contractor shall provide the worst case scenario.
E. This Contractor shall refer to the Architectural, Structural, Plumbing, Mechanical and Fire Protection Drawings and all other Drawings associated with the project,

prior to the installation or roughing of the electrical outlets, conduit and equipment to determine the exact location of all outlets.

1.03 WORK NOT INCLUDED

A. The following items of labor and material incidental and/or related to the installation of the electrical work will be provided and/or installed under other sections of the Specification.

1. All cutting, patching and furring.
2. Painting of all equipment and material other than factory finished.
3. Flashing
4. Excavation and backfill.
5. Concrete work.

1.04 DEFINITIONS

A. The "Electrical Contractor" specifically means, the Contractor working under this section for the specifications.
B. "Furnish and install" or "provide" means to supply, erect, install and connect up complete, in readiness for regular operation, the particular work referred to unless otherwise specified.
C. "Piping" includes, in addition to pipe, all fittings, boxes, hangers and other accessories relating to such piping.
D. "Concealed" means hidden from sight, in chases, furred spaces, shafts, hung ceilings and embedded in construction.
E. "Exposed" means visible in sight, not installed "concealed" as defined above.
F. "Approved Equal" means any equipment or material which is equal in quality, durability, appearance, strength, design and performance to the equipment or material specified and which will function adequately in accordance with the general design and is approved by the engineer.

1.05 CODES AND STANDARDS

A. Unless otherwise specified or indicated, materials and workmanship shall conform to the latest edition of the following Standards, Codes, specifications, Requirements and Regulations.

1. National Electrical Code
2. State Electrical code
3. National Electrical Contractors Association.
4. National Electrical Manufacturer's Association
5. Underwriters' Laboratories, Inc.
6. National Fire Protection Association
7. Local Wiring Inspector
8. Local Fire Marshall
9. State Fire Marshall
10. International Building Code
11. International Energy Conservation Code
12. All other State and Local Codes and/or Authorities having jurisdiction, including any and all other paragraphs of this Specification.

1.06 PERMITS AND FEES

A. The Electrical Contractor shall secure and pay for all required permits.
B. The Electrical Contractor shall carry in his bid price and pay all costs incurred for, standard to be performed in conjunction with this Contract that are necessary for and incidental to, the accomplishment of his work and the use of work when completed.
C. The Electrical Contractor shall, after completion, furnish to the General Contractor a Certificate of Final Inspection and Approval from the Local Electrical Inspection Department.

1.07 MATERIALS AND WORKMANSHIP

A. Materials and workmanship shall be the best of their respective kinds and in full accordance with the most modern construction methods.

B. Electrical materials and equipment of types for which there are Underwriters' Laboratories standard requirements, listings or labels, shall conform to their requirements and be so labeled.

1.08 TESTS

A. The right is reserved to conduct acceptance tests of all equipment, wiring or any other work furnished under these Drawings and/or Specifications to determine the fulfillment of specific requirements and/or design.

B. The Electrical Contractor shall conduct all such tests in the presence of authorized representatives of the Owner and at such times that the Owner may designate.

C. The Electrical Contractor shall perform all tests, supply all instrumentation, personnel and make all adjustments of equipment and wiring as may be necessary.

1.09 PORTABLE OR DETACHABLE PARTS

A. The Electrical Contractor shall retain in his possession and shall be responsible for, all portable and/or detachable parts and portions of the installation, including fuses, keys, locks, adapters, blocking clips, inserts, lamp instruction, drawings and all other devices or materials that are relative to and necessary for the proper operation and maintenance of the electrical system until final completion of his work.

1.10 PROTECTION AND CLEANING OF EQUIPMENT

A. All electrical equipment, upon receipt, shall be adequately stored and protected from damage.

B. After inspection, all electrical equipment shall be protected to prevent damage during the construction period. Openings in all conduits, raceways, fittings and boxes shall be closed to prevent entrance of foreign materials.

C. Before completion of work and before final inspection, all damaged and/or defective equipment and material shall be replaced and all exposed surfaces of electrical equipment shall be clean.

1.11 DRAWINGS AND SPECIFICATIONS

A. The Drawings and these Specifications are complimentary to each other and any labor or material called for by either, whether or not by both, necessary for the successful operation of any of the particular types of equipment furnished under this Contract, shall be furnished and installed.

B. Where a conflict arises between the drawings and specifications and/or within the drawings themselves the electrical contractor shall provide the worst case scenario.

C. Before installing any of the electrical work, see that it does not interfere with the clearances required for existing finished columns, pilasters, partitions, or walls. Installed work, which interferes with other trades, shall be changed as directed by the Owner's representatives.

1.12 OBTAINING INFORMATION

A. Obtain detailed information from the manufacturers of apparatus, which he is to furnish and install as to the proper method of installing and connecting same. Obtain all required information from the Owner's representative and other Subcontractors necessary to facilitate and complete the electrical work. Check all other Contract Drawings and all other sections of Contract Specifications for electrical equipment requiring connections and electrical characteristics of equipment should they differ from the Electrical Drawings.

1.13 SAFETY PRECAUTIONS

A. The Electrical Contractor shall furnish, place and maintain power guards and other necessary construction, required for the prevention of accidents to secure safety of life and/or property.

1.14 REMOVAL OF RUBBISH

A. After completion of the work, the Electrical Contractor shall remove all waste, rubbish and other materials left as a result of his operations and leave the premises in clean condition.
B. In addition to the cleaning up required in the Special Provisions, the Electrical Contractor shall, at the completion of the work, clean, polish, and/or wash all exposed items or materials, equipment and fixtures in this Contact, so as to leave such items bright and clean.
C. The Electrical Contractor shall repaint any painted metal surfaces, which have been scratched, dented, or marred.

1.15 COORDINATION OF TRADES

A. The Electrical Contractor shall give full cooperation to other trades and shall furnish (in writing, with copies to Engineers) any information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.
B. Where the work of the Electrical Contractor will be installed in close proximity to work of other trades or where there is evidence that this Contractor will interfere with the work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. All cutting and patching, excavation and backfill shall be done by the General Contractor. The Contractor shall inform the General Contractor well in advance as to his requirements.
C. This contractor shall be responsible for coordinating with all the dental equipment vendors to ensure that all power, data, control and lighting requirements are met throughout the building. Before any conduit or cable is run the electrical contractor shall coordinate with the appropriate dental vendor exact location of conduit entries to the various pieces of equipment. The electrical contractor shall coordinate all voltage and outlet configurations.

1.16 VISITING THE SITE

A. The Electrical Contractor shall be required to visit the site and examine the existing conditions, which may affect his work under this Contract.
B. The electrical contractor shall be responsible to “make-safe” all the existing structures in preparation for demolition. This contractor shall be responsible for coordinating with Central Maine Power Company before any power, telephone, fire alarm service, etc. are terminated.

1.17 FIELD MEASUREMENTS

A. The Electrical Contractor shall verify in the field all measurements necessary for his work and shall assume responsibility for their accuracy.

1.18 GUARANTEE

A. The Electrical Contractor guarantees by his acceptance of the Contract that all work installed will be free from any and all defects in workmanship and/or materials during period of one (1) year from date of Certificates of Completion and acceptance of work. If any such defects in workmanship or material appear, he will, without cost to the Owner, remedy such defects within a reasonable time.

1.19 SHOP DRAWINGS AND SAMPLES

A. Before ordering material shipped to the job, the Electrical Contractor shall submit to the General Contractor for approval manufacturers references and bulletins, Shop Drawings, in sextuplet, giving all details, dimensions, etc. of the following;

1. Primary cables (if applicable and approved by the utility company)
2. Primary transformer (if applicable and approved by the utility company)
3. Manholes/handholes
4. Light and Power panels
5. Main Service equipment
6. All lighting fixtures, lamps and ballasts
7. Lighting Controls (all components)
8. Time Controllers
9. Disconnect switches
10. Fire Alarm equipment
11. Emergency Lighting System components
12. Emergency Generator and Automatic Transfer Switches
13. Wiring Devices (each type)
14. Wiring (each type)
15. Tel/data, equipment, wiring devices, wire, patch panels, racks, ect.
16. Lightning Protection equipment and wiring
17. Security equipment, if applicable

B. Should the Electrical Contractor choose to substitute for the specified equipment, the Shop drawing submittals must include catalog cuts of originally specified equipment. Shop Drawings submitted for approval without all of the required information will not be considered for approval.

1.20 SUPERINTENDENCE OF WORK

A. The Electrical Contractor shall give his personal superintendence to the work and shall retain at the job site during the period of construction, a competent Foreman, satisfactory to the Contractor, who shall be in full charge of the work under this section.

1.21 STORAGE OF MATERIALS

A. The Electrical Contractor shall store his material and equipment before installation only where designated by the General Contractor. He shall be responsible for all his property stored on the premises and shall hold the General Contractor free form liability for loss by theft or carelessness of employees of the General contractor or of other Sub-Contractors. The Electrical Contractor shall take particular care to protect any finished work for injury or defacement and must remedy, at his expense, any injury cased thereto by his operations.

1.22 RECORD DRAWINGS

A. The Electrical Contractor shall maintain at the site a set of black line prints on which shall be accurately shown the actual installation of work under this section, indicating therein and variation, approved by the General contractor, from the Contract Drawings, including changes in sizes, locations and dimensions at the conclusion of the work, the Electrical Contractor shall deliver to the General Contractor for submittal to the Owner, a complete set of reproducible Record Drawings showing the entire work as actually installed and two (2) sets of black or blue line on white prints.

1.23 CONTRACT DRAWINGS

A. The Contract Drawings are generally diagrammatic and are intended to convey the scope of work and indicate general arrangements of equipment, conduits, piping and fixtures.
B. If directed by the General Contractor, the Electrical Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

1.24 TEMPORARY SERVICE

A. Furnish and erect a suitable backboard for temporary meters and switches to measure and control current for testing, wiring, motors and other appliances; for temporary lighting, machines or the apparatus used in the construction of the building, until such time as the permanent meter is installed. Furnish and mount on this temporary board, an approved type of service switch and do all necessary wiring to connect such circuits as required.
B. Special heavy-duty circuits shall be paid for by the trade requiring same.
C. Obtain city-wiring permit for the temporary wiring and pay all fees for same.

PART 2.00 – PRODUCTS

2.01 RIGID STEEL CONDUIT

A. All rigid steel conduit shall have a hot-dipped galvanized coat plus a secondary coat, galvanized threads, bear an Underwriters' Laboratories label and shall conform to Federal Specifications WW-C-581d and American Standards Association Specification C80.1. The conduit shall be fully threaded at both ends and each length shall be furnished with one standard threaded coupling. The use of threadless conduit couplings and fittings will not be permitted. Threaded split couplings of the bolted clamp type are permitted. Rigid steel conduit shall be used for all power wiring where indicated.
B. Galvanized rigid steel conduit sweeps and quarter bends shall be installed at the utility company transformer and at the utility company poles. Each sweep to a pole shall extend ten feet up the pole with galvanized rigid steel conduit.
C. Galvanized rigid steel conduit shall be installed were conduit needs to pass under roadways.

2.02 ELECTRICAL METALLIC TUBING

A. Electrical metallic tubing shall be Electro-galvanized outside and enameled inside. All electrical metallic tubing shall bear an Underwriters' Laboratories label and shall conform to Federal Specifications WW-C-563 and American Standards Association Specification C80-3.
B. Couplings and fittings for EMT shall be of the compression type or set screw type. EMT shall not be installed embedded in concrete, outdoors or in wet locations.
C. Any exposed wiring within the facility shall be installed in Electrical Metallic Tubing.
D. Conduit sleeves shall be installed at all floors for voice/data network connectivity. Sleeves shall be fire rated to maintain the integrity of the floor assembly.

2.03 FLEXIBLE METALLIC CONDUIT

A. Flexible metal conduit shall be galvanized steel, and shall contain an integral copper grounding conductor. Liquid-tight flexible metal conduit shall be similar, but shall also have an extruded moisture and oil-proof outer jacket of polyvinyl chloride plastic.

B. Flexible metal conduit shall be utilized on all vibrating electrical equipment and shall be no greater than three feet in length.
C. Liquid-tight flexible conduit shall be utilized on final connections to any outdoor equipment.

2.04 PVC CONDUIT

A. Plastic conduit shall be PVC Schedule 40, iron pipe size, rigid polyvinylchloride equal to or better than ASTM Pipe Material ASTM PVC conduit Type 2, Grade 1, ASTM PVC 2110, Specification P-1785, Underwriters' Laboratory, Inc. approved for lengths beyond ten (10) feet shall be identical to the approved conduit. Where elbows are used, they shall be long radius type. PVC Conduit shall be manufactured by Kraloy, Barrett Division of Allied Chemical, Pittsburgh; Triangle Cable and Conduit Co., or approved equal.
B. Schedule 40 PVC conduits shall be installed, directly buried in earth as indicated on the drawings.
C. PVC conduits shall come in 10'-0" lengths and multiple lengths are coupled together they shall be connected with a coupling and PVC glue.
D. PVC Glue by Gorilla shall be non-flammable, low odor with no harmful fumes. The glue shall be fast acting to adhere to conduits and couplings and shall meet or exceed NSF, ASTM D-2564, IAPMO and R &T standards. The glue shall not require any primer require only the use of water for any spills or clean up.
E. Conduits shall be installed as indicated on the drawings and all empty conduits shall be supplied with a ¼" nylon pull string. The pull string shall run the entire length of each conduit with at least 24 inches of slack at each end.
F. All conduits entering or leaving a transformer, hand hole, manhole or any other enclosure shall be done with 22.5 degree sweeps and each sweep shall be provided with bell ends.

2.05 WIREWAYS

A. Totally enclosed sheet steel wireways, complete with all fittings, tees, elbows, wire retainers, closure plates, hangers, and component parts required for a complete installation shall be installed in all areas indicated on the Drawings and as required to facilitate the installation of the electrical systems.
B. Physical size, length, and internal cross sectional areas, of the wireways shall be determined in the field by the Electrical Subcontractor to suit field conditions unless noted otherwise on the Drawings.
C. The wireway systems shall be constructed of code gauge galvanized sheet steel with hinged cover. Straight sections of the wireway system shall be constructed of two separate pieces of sheet steel. One piece shall be used to form the sides and top, the other to form the cover. Captive screws, furnished as a part of the wireway system, shall be used for sealing at all hinged covers and coupling at straight sections or fittings.
D. All fittings, elbows, tees, and straight sections of the wireway shall be provided with smooth and round edges to protect the wiring from abrasion. All welded seams and joints shall be ground and polished to remove burred edges.
E. A bonding jumper consisting of an insulated flexible #8 AWG copper conductor with soldered eyelet on each end shall be provided to bound and ground the wireway at each joining section of the wireway system. The bonding jumpers shall be attached to each section by means of a bolt, locknut, and washer. The Electrical Subcontractor shall remove the paint from the wireway at the contact points so that positive contact shall be made between the bare metals at each grounding point.
F. The wireway system shall be provided with ½ inch and ¾ inch concentric knockouts every 6 inches on center along the top and ½ inch, ¾ inch, 1 inch, and 1-1/4 inches concentric knockouts every 6 inches along both sides.

G. All sheet metal posts shall be factory primed with rust inhibiting phosphor coating and finished with USASI #24 dark gray enamel. All hardware shall be cadmium-plated to prevent rusting and corrosion.

H. All lengths, connectors, and fittings of the wireway systems shall be UL approved and bear the Underwriters' Laboratories label. UL listing of lengths without listing of connectors and associated components or fittings shall not be acceptable.

I. The wireway system, all component parts and fittings, shall be by one manufacturer and shall be manufactured by Kelek, Lee Products, Keystone or equal.

2.06 OUTLET, PULL AND JUNCTION BOXES

A. The locations of all wall switch boxes shall be coordinated with the Drawings and Project Manager before installation of same. All switch boxes unless specifically noted otherwise on the Drawings shall be opposite the hinged side of the door for all single doors.

B. The location of outlets shown on Drawings are approximate. The Electrical Contractor shall study the building plans in relation to the spaces and equipment surrounding each outlet, so that receptacles, switches, lighting fixtures, devices, or other electrical components are symmetrically located and mounted in or on the walls, ceiling, and floor.

C. Outlet, junction or pull boxes, shown on the Drawings, that interfere with the installation of mechanical equipment, structural or architectural features, or that will be inaccessible due to the work of other trades shall be relocated accordingly.

D. Outlet, junction or pull boxes that are not specifically shown on the Drawings but are required for the proper installation of the electrical system shall be installed by the Electrical Contractor, so that they do not interfere with the structural or architectural features and the installation of materials by the other trades.

E. Any reasonable change in the location of outlets, pull or junction boxes requested by the Architect, prior to roughing, shall not involve additional expense to the Owner.

F. All outlet, pull and junction boxes shall be installed in a rigid and satisfactory manner and shall be supported by bar hangers in frame constructions or shall be fastened directly with wood screws on wood, bolts with expansion shields on concrete or brick, toggle bolts on hollow masonry units and machine screws or welded threaded studs on metal. Threaded studs of the proper type and holding capacity driven in by a powder charge and provided with lock washers and nuts are acceptable for mounting of boxes on solid concrete walls or slabs. Preset inserts of the proper type and holding capacity shall be used in overhead slab construction wherever possible for the support of pull and junction boxes.

G. Feeders passing through pull or junction boxes shall be individually grouped and bound with tie-raps. The feeders in each pull or junction box shall be properly tagged to clearly indicate their electrical characteristics, circuit number and panel designation. Cables shall be supported on suitable racks within the boxes and arranged in an orderly manner.

H. Flush mounted ceiling and wall outlet boxes shall be provided with the proper type extension rings, tile and plaster collars required to set flush with the finished surfaces of the ceiling or walls.

I. Outlet boxes shall, in general, be as follows:

1. Exposed, surface and pendant mounted outlet boxes or outlet boxes installed in normally wet locations shall be of the cast metal type with threaded hubs as manufactured by Crouse-Hinds, Appleton, Red Dot, or Russell and Stoll.
2. Recessed outlet boxes for non-hazardous locations shall be of the pressed sheet steel, zinc coated, cadmium plated type.
3. Outlet boxes shall not be less than 1-1/2 inches deep unless shallower boxes are required by structural conditions and are specifically approved by the Architect.
4. Ceiling and bracket outlet boxes shall not be less than 4 inch octagonal, except that smaller boxes may be used where required by the particular fixture to be

installed. Flush or recessed fixture shall be provided with separate outlet boxes where required by the future terminal temperature requirements.

5. Outlet boxes for general use, flush mounted in concrete work and walls in non-hazardous and normally dry locations, shall be manufactured by Steel City, Appleton, Raco or equal.

J. Pull and junction boxes shall, in general, be as follows:

1. Pull and junction boxes shall be constructed of code gauge galvanized sheet metal, of not less than minimum size required by the N.E.C. or other applicable Specification "STANDARDS" and shall be furnished with securely fastened covers. Boxes exceeding 48 inches in any direction shall be properly reinforced with angle iron stiffeners.
2. Pull and junction boxes of other than standard manufacturer's trade size shall be manufactured by Keystone, Lee Products or Empire.
3. Standard trade size pull and junction boxes shall be produced by the manufacturers listed above as applicable.
4. Pull and junction boxes to be installed in normally wet location areas shall be of the cast type with threaded hub and gasketed coverplate. The cast pull and junction boxes shall be manufactured by O.Z., Crouse-Hinds, Appleton or equal.

K. Outlet, pull, and junction boxes shall be properly sealed during the course of construction to prevent the entrance of dirt and foreign materials within same or the raceway system of which it is a part. The Electrical Contractor shall provide temporary covers for all open boxes. Paper may be solidly packed into standard work boxes to prevent the entrance of dirt and foreign materials, in lieu of coverplates if so elected by the Electrical Contractor.

2.07 AIR VAPOR BARRIER BOX

A. Electrical contractor shall provide air-vapor barrier boxes at outlet boxes installed within any vapor barrier to provide airtight construction around all the outlets.

B. The air-vapor barrier boxes shall be made of rigid polyethylene with a hinge feature to allow easy installation of any standard electrical outlet box.

C. The air-vapor barrier boxes shall be installed by the electrical contractor and sealed by the air sealing contractor.

D. The air-vapor barrier boxes shall be designed and installed to protect the seal made around the wires that enter or leave the box.

E. The air-vapor barrier box shall allow for inspection and verification of a complete seal with air vapor barrier material before the wall is closed. This shall be coordinated in the field with the air sealing contractor.

2.08 FIRE STOPPING

A. Electrical contractor shall provide Intumescent fire stopping all around each conduit that penetrates a rated wall, floor and/or ceiling. Fire stop putty shall all 10% movement and be water-based intumescent acrylate and have a shelf life of 12 months. The fire stopping shall be skin forming within 15 minutes and have an application temperature from 5 degrees C to 40 degrees C. Fire stopping shall be manufactured by Hilti.

B. Fire stop putty pads shall be installed around outlet boxes that are located on party walls and/or fire rated walls or ceiling assemblies. Putty pads shall be intumescent, non-conductive, synthetic rubber and free from asbestos. The putty pads shall have an application temperature from 5 degrees C to 35 degrees C and a reaction temperature of 140 degrees C with a shelf life of 24 months. Putty pads shall be FM and UL 263 approved and manufactured by Hilti.

2.09 METAL CLAD CABLE

A. All conductor wires and cables for secondary circuits shall consist of thoroughly tinned 98 percent conductivity copper, with 600 volt nylon-covered (75 degrees C)

insulation with an interlocked galvanized steel armor, insulated bushings, manufactured in strict accordance with the requirements of the Board of Underwriters' and the A.I.E.E..

B. Wires, #10/2 w/GRD., #12/2 w/GRD., and #14/2 w/GRD., Metal Clad cable, type "MC", shall be type "THHN" solid, unless otherwise noted or shown on plans; sizes #6 AWG and larger shall be stranded Type "THHN".

C. No wire smaller than 12/2 w/GRD. metal clad cable shall be used for any branch circuit. Larger sizes shall be used where so indicated on the plans.

D. All wire shall be color-coded.

E. Type MC cable shall not be used in concrete, direct buried in earth or where exposed to chemical vapors.

F. Type MC cable can be used as panel feeders, branch circuits, run exposed, run concealed, in raceway, as open runs above ceilings, etc.

G. Type MC cable shall be secured by insulated staples, cable-ties, straps and/or hangers at intervals not to exceed 6'-0' on center and within 12" of every cabinet, box or fitting.

H. In addition to the line and neutral conductors, all Metal Clad cable shall be equipped with a full size, green insulated ground conductor that runs the entire length of every branch circuit. Type "AC" shall not be permitted.

2.10 WIRES AND CABLES

A. Unless otherwise specified, all wires and cables shall be thoroughly tinned 98% conductivity copper, single conductor type "THHN" moisture and heat resistant polyvinylchloride thermoplastic for use at 600 volts A.C. and D.C., rated 60 degrees C. operating temperature. Wires and cables #6 AWG and larger shall be type "THHN", unless noted otherwise. The wires and cable shall have the Underwriters' Laboratories, Inc. label and be surface printed throughout the entire length at two-foot intervals with permanent identifying markings indicating manufacturer's name, size, type, and voltage. All wire and cable shall be furnished on reels or spools and in lengths required to minimize splicing.

B. Fixture wiring for use on 250 volts A.C. shall be type XFF, cross linked, polyfin insulated, #14 AWG, 300 volts.

C. Branch circuit wire in continuous raceways shall be type "THHN", heat resistant, nylon covered thermoplastic.

D. Wires of #12, and #10 AWG shall be solid or stranded, #8 AWG and larger shall be stranded.

E. Wires and cables #2 AWG and smaller shall be of continuous solid colors follows:

1. SYSTEM VOLTAGES: 120/208 3 PH., 4 WIRE

Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Equip.Grd.	Green

2. All wires larger than #2 AWG shall be color-tape coded at all terminations.

2.11 LIGHTING FIXTURES

A. The Contractor shall furnish and install the lighting fixtures, complete for each and every light outlet in the type quality, and size of fixture indicated on the Plans and in the Fixture Schedule, unless called for specifically to be omitted herein. It shall be the responsibility of this Contractor to check the Plans with the Schedule for completeness. No substitutes will be accepted.

B. This Contractor shall include all fixture wiring, hanging, uncrating, connecting up and making ready for operation. All fixture wire for fixtures shall not be less than #16 gauge, but larger if capacity of fixture requires it, and finished with asbestos-covered wires where exposed to excessive heat.

C. This Contractor shall include the cost of furnishing and installing all lamps for all fixtures under this Contract throughout. All lamps for all fixtures shall be furnished in types as indicated. All lamps for Rapid-Start fixtures shall be General Electric, Westinghouse, or Sylvania, as called for under each fixture type.

D. The Contractor shall check structural and architectural details of all locations where fixtures are to be installed so that he can properly provide for installation of the fixtures.

2.12 LIGHT SWITCHES (Commercial Spec. Grade)

A. All local wall switches shall be of the flush Quiet style, single pole, double pole, three-way or four-way, as required and as manufactured by Pass & Seymour / Legrand.

B. All switches shall be suitable for the control of tungsten filament lamps, fluorescent loads and shall carry the proper marking of the Underwriters' Laboratories.

C. Switches shall be equal to the following Pass & Seymour / Legrand devices:

Single-pole PS2621
Three-way PS2623
120 Volt Fluorescent Dimmer PS934821

D. Color of devices shall be selected by the architect.

2.13 OCCUPANCY SENSORS

A. The electrical contractor shall furnish and install a wall mounted, dual technology, passive infrared (PIR) and ultrasonic occupancy sensor as indicated on the drawings. Each occupancy sensor shall turn lights on when PIR and ultrasonic technologies detect occupancy.

B. The PIR technology shall sense the difference between infrared energy from a human body in motion and the background space. The ultrasonic technology shall utilize the Doppler Principle and high frequency (40kHZ) ultrasound to sense motion within each space.

C. Once the lighting is "on" either technology will hold the lights "on". When no occupancy is detected for the length of the pre-determined time delay, the lights turn "off".

D. Each occupancy sensor shall be able to be set so that only one of the technologies is needed to turn lights "on" or both technologies can hold the light "on".

E. Each occupancy sensor shall be 24 volt DC/AC equipped with an isolated relay with Normally Open and Normally Closed contacts rated for 1 amp @ 24 volts DC/AC

F. Each occupancy sensor shall have built-in time delays as follows; automatic, fixed (5, 10, 15, 20 or 30 minutes), walk through and test mode.

G. Each occupancy sensor shall have Sensitivity adjustments as follows; Smart Set (automatic) or reduced sensitivity (for PIR sensitivity); ultrasonic sensitivity is variable with built-in trimpot.

H. Each occupancy sensor shall be equipped with a 2-200 footcandle light level sensor and shall have a low voltage momentary switch input for manual operation.

I. Sensors shall be capable of multi-sensor application to allow for zone control.

J. Each occupancy sensor shall work with a power pack be UL and CUL listed and come with a five year factory warranty.

2.14 LIGHT SAVER POWER PACKS

A. The electrical contractor shall furnish and install a light saver power pack with each dimming controller. The power pack will be DIN rail mounted in the same 8" x 8" x 4" NEMA I enclosure mentioned above.

B. Each power pack shall multi-voltage (120/230/277 volt) on the primary side and 24 volts on the secondary side.

C. Each power pack shall provide 1000 ma for three (3) normally open 620 va relays @ 120 volts.
D. Each power pack shall connect to it respective dimming controller via RJ12 quick connect jack and cable that will be furnished with each power pack.
E. Each power pack shall have integral fuse protection and a Green power LED light.
F. Each power pack shall be UL and CUL listed and come with a five year factory warranty.
G. Each power pack shall be manufactured by Watt Stopper #BT-203.

2.15 DIMMING CONTROLLER/ POWER PACK ENCLOSURE

A. The electrical contractor shall furnish and install a NEMA I (8" x 8" x 4") electrical enclosure above the ceiling in each classroom.
B. Each enclosure shall be suitable for indoor, dry location use and come with a single, pre-mounted DIN rail and screw cover.
C. Each DIN rail shall be capable of holding a single dimming controller and a single power.
D. Each enclosure shall be manufactured by Watt Stopper #LS-E8.

2.16 DAY LIGHT (PHOTO) SENSORS

A. The electrical contractor shall furnish and install a ceiling mounted photosensers as indicated on the drawings. Each photosensor shall provide daylight data necessary for the operation of each dimming control system.
B. Each photosensor shall have the ability to continuously measure ambient light levels from incoming daylight from the window walls while differentiating from electrical light.
C. Each photsensor shall have three (3) selectable footcandle ranges from 3-300 fc; 30-300 fc and 60-600 fc.
D. Each photosensor shall be a low voltage, Class 2 device and wired with a 3 conductor #22 AWG, plenum rated twisted cable equal to Belden #8443.
E. Each photosensor shall be UL and CUL listed and come with a five year factory warranty.
F. Each photosensor shall be manufactured by Watt Stopper #LS-290C

2.17 RECEPTACLES (Commercial Spec. Grade)

A. All convenience outlets shall be of the single or duplex type, back or side wired, T-slot and polarized slot type. All receptacles shall be of the grounded type and be rated 20-amp as indicated. Receptacles shall be manufactured by Pass & Seymour / Legrand or Hubbell and shall be Plug Tail Style.
B. Receptacles must feature a solid brass strap with integral ground break-off ears, brass auto ground clip crimped to the strap, wrap around face locking strap and locking drive screws and wide body design.
C. All receptacles must be finger safe with built-in brass terminals to accept plug tail connector with solid or stranded #12 awg conductors, including the ground conductor. The connector shall have large brass contacts with an audible snapping latch to assure connection and allow release.
D. All receptacles must be finger safe with no exposed terminals after installation and shall have circuit identification in the label on the face of each receptacle.
E. Exposed molded parts of the receptacles must be constructed of high impact-resistant nylon or polycarbonate and must match the faceplates.
F. In general, convenience outlet circuits shall be independent of light circuits and shall not be controlled by light circuit switches or light switches, unless specifically shown.
G. All twenty-amp circuits indicated on the drawings shall be wired to twenty amp devices. The use of a fifteen amp rated receptacle on a twenty-amp circuit is not acceptable.

H. Standard duplex receptacles specified shall be used for dual circuited receptacles by removal of break-off shunt.

I. Exterior receptacles and/or receptacles in wet locations shall be provided with an "in-use" cover in accordance with Article 406 of the National Electrical Code. Covers shall be polycarbonate construction with a watershed channel, cord flap gasket, 1" profile and have the ability of being installed without removing a device through the use of keyed mounting holes. In-use covers shall be manufactured by Pass & Seymour/Legrand # WIUC10-SC or Hubbell.

J. All wiring devices throughout each Patient Care area shall be hospital grade devices in accordance with Article 517 of the National Electric Code.

K. All wiring devices throughout the facility shall be provided with a circuit directory on its respective face that is comprised of the panel designation power originates from along with the exact branch circuit number. (ie, LP1A-10)

L. All receptacles installed throughout the building complex shall be as follows, or equal to:

1. Duplex convenience receptacles 20A, 125V, single phase, 3 wire U-slot grounded type shall be Pass & Seymour / Legrand #PT8300/PT6STR or Hubbell.
2. Duplex 20A, feed thru, 125V, single phase, 3-wire, U-slot ground fault interrupting convenience receptacle shall be Pass & Seymour / Legrand #2094-I or Hubbell.
3. Hospital Grade convenience receptacles shall be 20A, 125 V., singles phase, 3 wire, U-slot, grounded type with a Green LED illuminated face. Pass & Seymour / Legrand #PT8300ILI or Hubbell.
4. Exact NEMA configuration of all special purpose outlets shall be coordinated in the field with the equipment manufacturer and/or the General Contractor.

2.18 MISCELLANEOUS GENERAL PURPOSE DEVICES

A. All other special and general-purpose receptacles called for on the Drawings shall be of the same grade as indicated above, ivory phenolic compound finish and manufactured by Leviton, Hubbell, P&S or equal.

2.19 DEVICE PLATES

A. All plates used on switch and plug receptacles in finished spaces where wiring is concealed, shall be non-metallic type. Plates on exposed conduits to be sherardized. Non-metallic type shall be ivory color to match devices.

B. Gang plates shall be used where multiple switches and/or receptacles occur at one location.

C. Plates shall be of the same manufacturer as the wiring devices or equal.

2.20 FLUORESCENT BALLASTS

A. All fluorescent ballasts as indicated shall be of the electronic type and their design and construction shall conform to the CBM Standards certified by ETL.

B. The ballast fill material shall be of thermosetting type and shall not soften under failure. The ballasts shall be equipped with an internal automatic resetting thermal protector adjacent to the coils. The ballast case temperature shall not exceed 90 degrees C in continuous operation.

C. Fluorescent ballast's shall be electronic type with full light output as manufactured by Advance Ballast Company or approved equal.

D. Ballast's shall be Instant Start, Class P and shall be in accordance with the schedule set forth by the National Electrical Code.

E. Compact Fluorescent ballasts shall be One-Lamp, Encapsulated, Electronic type. Ballasts shall be Class P with sound rating A and Automatic Resetting feature. Compact Fluorescent ballast's shall be as manufactured by Advanced Ballast Company or approved equal.

F. Compact Fluorescent Dimming ballast's shall be One-Lamp, Encapsulated, Electronic type at full light output. Dimming Ballast's shall be Class P with sound

rating A and Automatic Resetting feature. Dimming Ballast's shall be capable of dimming down to 20 percent of the rated lumen output using a standard U.L. listed incandescent dimmer switch. Compact Fluorescent Dimming ballast's shall be manufactured by Advance Transformer Company, Energy Saving Ballast's Company or approved equal.

2.21 LIGHTING CONTROL SYSTEM

A. The Electrical Sub-Contractor, as part of the work of this section, shall coordinate, receive, mount, connect and place into operation the lighting control panels indicated on the drawings. The system and all of its components shall be manufactured by Gentec or equal. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for the complete and properly functioning lighting control system as described herein and shown on the plans.

B. Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, a qualified factory representative shall completely check the installation prior to energizing the system. At the time of checkout and testing, the User Agency's representative shall be thoroughly instructed in the proper operation to the system.

C. Manufacturer's products shall be listed by Underwriters Laboratories, Inc. (U.L.) and comply with the National Electrical Code (NEC) and local building codes that apply.

D. The equipment specified herein shall be the coordinated product of a single manufacturer. All controls and cabinet fabrication must take place in the manufacturer's plant. The use of subcontracted component assemblers is not acceptable.

E. The manufacturer shall be one who has been continuously engaged in the manufacture of lighting controls for a minimum of ten years.

F. All equipment shall be 100% tested as a complete system. Manufacturers using sample testing methods are not acceptable.

G. All equipment shall be warranted free of defects in materials and workmanship for a period of one year from date of turn-on.

H. System Testing

1. All relays shall be assembled into the cabinets and all interwiring completed at the factory prior to shipment. All relays shall be simultaneously connected to their respective loads, all control stations shall be connected to the cabinet (or cabinets) and testing shall be done as a complete system under power at the factory prior to shipment. This testing shall include exercising all functions such as take control, transferring, mastering, or other special control provisions, and this shall be done for each individual control and control station included in this system. Control system shipped as components for job site assembly or that are not completely tested as a system at the factory prior to shipping shall not be acceptable. Sample testing methods are not acceptable.

I. Equipment

1. The switching control system shall be a modular design and shall occupy the same space in the enclosure as other relay modules, photo sensors and time switches, thereby allowing complete interchange ability between system components.
2. Lighting control panels shall be as indicated on the drawings. The control panels shall be complete with 20 amp relays rated 277 volts, a time clock with astronomical functions that automatically adjust to day light savings and seasonal changes, photocell capability and remote momentary switches capable of controlling groups of relays and/or a single relay. The panel shall have the number of channels as indicated on the drawings and shall be

easily programmable in the field. Programming instructions shall be embossed on the inside of the door to the unit and when more than one panel is indicated the panels shall be capable of be linked together through a data loop. The lighting control panels shall be Gentec or equal.

3. Two integrated contact closure inputs for interface with occupant sensors and day light sensors shall be provided.
4. The panels shall be capable of providing digital control for up to 30 circuits per panel.
5. The circuits and channels shall be the capable of being programmed to be controlled independently or as part of a scene.
6. Four button momentary switches shall be a part of the installation. The exact quantity and location of the switches shall be as indicated on the drawings.

J. Installation

1. It shall be the responsibility of the Electrical Contractor to receive and store the necessary materials and equipment for the control system. It is the intent of these specifications and plans to include everything required for proper and complete installation and operation of the lighting control, even though every item may not be specifically mentioned. The contractor shall timely deliver to other trades any equipment that must be installed during construction.
2. The Electrical Contractor shall be responsible for field measurements and coordinating the physical size of all equipment with the architectural requirements of the spaces into which they are to be installed.
3. The Electrical Contractor shall install all lighting control equipment in accordance with manufacturer's shop drawings.
4. All branch load circuits shall be live tested by the Electrical Contractor before connecting the loads to any of the relay module load terminals.

K. Manufacturer's Services

1. Upon completion of the installation including testing of load circuits, the contractor shall notify the system manufacturer that the system is available for formal checkout. This notification is to be given in writing two weeks prior to the time factory trained personnel are needed on the job site. At the manufacturer's discretion, formal turn-on can be waived. No power is to be applied to the system unless specifically authorized by written instructions from the manufacturer.

2.22 LIGHTING CONTACTORS

A. Lighting contactors shall be suitable for ballasted lamps and filament at 480 volts maximum.
B. The lighting contactors shall be 12 poles and mechanically held and designed to handle the switching of tungsten or ballasted lamps as well as other non-motor loads.
C. The contactors shall be designed to withstand the large initial inrush currents of tungsten and ballast lamp loads as well as non-motor (resistive) loads without contact welding
D. The contactors shall be rated 30 amperes per pole.
E. The contactors shall have an interlock that removes the power from the pickup coil and shall require application of power to release the contactor to the OFF position
F. The contactors shall be capable of operating such that it will not switch to OFF during power failure to the control circuit
G. The contactor shall be installed in a NEMA 1 enclosure

H. Mechanically-held contactors shall be Eaton / Cutler-Hammer type C30CN for 30 ampere rating.

I. 30 ampere rated contactor shall have finger safe terminals and normally open and normally closed poles shall be interchangeable where the installation of the pole on the contactor base determines if the pole is normally open or normally closed and not the pole itself. Contactor shall be field configurable from electrically held to mechanically held.

2.23 A.C. PANELBOARDS

A. Panelboards and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA and UL as follows: UL 67 – Panelboards, UL 50 – Cabinets and boxes, NEMA PB1, Fed. Spec. W-P-115C and Circuit breaker – Type I class I.

B. The convertible distribution and lighting circuit breaker panelboards shall be the dead-front type with door and door construction and shall be in accordance with the Underwriters' Laboratories, Inc. "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled.

1. All cabinets shall be made of code gauge steel or better and if painted shall be undercoated with a rustproof bonderized surface or galvanized and treated with a non-acid agent prior to painting. Fronts, provided with doors, shall be cold-rolled sheet steel with gray finish. Directory frames shall be included on the backs of all doors. All locks shall be keyed alike. Fronts shall be furnished with approved adjustable trim clamps and means shall be provided for entrance to gutter space, lugs, etc.
2. Circuit breakers shall be 1" per pole and be of the bolt-on type, stab types will not be permitted, indicating "ON-OFF" "TRIPPED" positions of the operating handle. When the breaker is tripped automatically, the handle shall assume a middle position between an overload on one pole shall automatically cause all poles to open. Two or more single pole breakers with one handle extension will not be permitted. The circuit breakers shall be quick-break on manual, as well as automatic operation and shall have inverse time characteristics secured through the use of a bi-metallic tripping element supplemented by a magnetic trip. Circuit breaker arc quenching shall be equal to or better than the "De-Ion" arc extinguishing principle.
3. All panelboard assemblies shall be factory assembled complete with circuit breakers as shown on the Contract Plans. Interiors shall be so designed and assembled that any individual breaker can be replaced without disturbing adjacent units or without removing main bus or branch circuit connectors. All bussing shall be copper. Main bus bars and back pans of distribution and power panelboards shall be of such design that branch circuits may be changed without additional machining, drilling, or tapping. Where copper contact surfaces are furnished on main and branch circuit connectors, the copper shall have a 1,000 amperes/square inch density and contact surfaces of not more than 200 amperes per square inch. Silver Plated contacts which meet the same values are acceptable. Lighting and power branch circuit panelboards shall be so designed that the branch circuit connections to the main bus provide sequence (fully distributed) phasing, and such connections shall be clearly and permanently identified on the face of the front of the panel interior.

C. A.C. Power Distribution Panels shall be convertible circuit breaker distribution Panelboards as manufactured by Cutler Hammer or General Electric.

D. Frame size for each breaker shall be as shown on the Contract Plans. All bussing shall be copper. The bare, solid, copper neutral bus shall be electrically insulated from the panel and a separate, bare copper grounding bus shall be provided in each panel. Copper ground bus shall be the equivalent of the solid neutral bus. Buses shall be clearly identified.

E. A.C. Lighting Panels shall be circuit breaker Panelboards as manufactured by Cutler Hammer or General Electric. Frame size for each breaker shall be as shown on the Contract Plans. All bussing shall be copper. The bare solid copper neutral bus shall be electrically insulated from the panel and a separate, bare copper grounding bus shall be provided in each panel. Copper grounding bus shall be the equivalent size of the solid, neutral bus. Buses shall be clearly identified.

F. Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts.

G. Doors shall have a semi flush cylinder lock and catch assembly. Doors over 48 inches in height shall have auxiliary fasteners.

A directory card with a clear plastic cover shall be supplied and mounted on the inside of each door. All locks shall be keyed alike.

2.24 SAFETY SWITCHES AND FUSES

A. Safety switches shall be of the fusible or non-fusible type as indicated on Drawings equipped with an external lever or handle for manual operation. Each unit shall be enclosed in a code-cage, sheet steel cabinet suitable for surface mounting as indicated on the drawings. Surface mounted units shall have hinged door and catches. Neutral conductors shall be solid throughout. Weatherproof switches shall be of the NEMA 3R type.

B. Safety switches shall be heavy duty type as manufactured by Square D Company, General Electric Company, Westinghouse, or I.T.E.

C. Furnish and install a complete set of fuses for installation and deliver to the Owner one set of spare fuses. Fuses shall be as manufactured by Chase Shawmut, Bussman, or Littlefuse/Tracor.

2.25 GENERAL PANEL INFORMATION

A. All panels shall be properly balanced, the circuit numbers on the Plans being a numerical indication rather than any attempt to indicate proper balance.

B. Care shall be taken in the use of a common neutral to make certain that no more than one leg is taken from each phase.

C. Typed indexes shall be provided in each panel indicating circuit number and the outlets or items controlled or fed from same.

2.26 MAIN DISTRIBUTION EQUIPMENT

A. Furnish and install the service entrance switchboard as herein specified and shown on the associated electrical drawings. The switchboard shall meet all the requirements set forth by Underwriters' Laboratories and shall be listed and labeled.

B. The switchboard framework shall be fabricated on a die-formed base or base assembly consisting of formed steel and commercial channel welded or bolted together to rigidly support the entire shipping unit for moving on rollers for mounting. The framework is to be formed code gauge steel, rigidly welded and bolted together to support all cover plates, bussing, and component devices during shipment installation. Each switchboard section shall have an open bottom and individual removable top plate for installation and termination of conduit. Top and bottom conduit area is to be clearly shown and dimensioned on the Shop Drawings. The wireway front covers are to be hinged to permit access to the branch breaker load side terminals without removing the covers. All closure plates shall be screw removable and small enough for easy handling by one man. The paint finish shall be gray enamel over a rust-inhibiting phosphate primer.

C. The switchboard bussing shall be plated copper and of sufficient cross-sectional area to continuously conduct rated full load current with a maximum average temperature rise of 65 degrees C. above an ambient temperature of 40 degrees C. The bus bars shall be rigidly braced to comply with the integrated equipment rating of the switchboard. The horizontal bus bars between sections shall be located on the back

of the switchboard to permit a maximum of available conduit area. The end section is to have bus bar provisions for future addition of a switchboard section. The provisions shall include the bus bars installed to the extreme side of the switchboard and prepunched to facilitate future bolted splice plates. The horizontal main bus bar supports, connections, and joints are to be bolted with grade 5 carriage bolts and Belleville washers to be free of required periodic maintenance. The switchboard shall be bus sized and metered as shown on the Drawings.

D. The switchboard, as a complete unit, shall be given a single integrated equipment rating to meet the available fault current as coordinated with the local utility company or a minimum of 65,000 amperes symmetrical fault current or larger as recommended by the manufacturer. The switchboard manufacturer shall certify that all equipment is capable of withstanding the stresses of a fault equal to that of the fault current mentioned above at lowest rated overcurrent protective device contained therein. Certification shall be established by factory tests done by the manufacturer on similar equipment. This test data shall be available and shall be furnished to the Engineer, if requested, with or before the submittal of approval Drawings.

E. The main circuit breakers shall have the capability of being 100% rated and meet all the requirements specified below.

F. Each low-voltage power circuit breaker and insulated case circuit breaker shall be equipped with a solid-state tripping system consisting of three current sensors, microprocessor-based trip device and flux-transfer shunt trip. Current sensors shall provide operation and signal function. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached. Interchangeable current sensors with their associated rating plug shall establish the continuous trip rating of each circuit breaker. The trip unit shall be Eaton type Digitrip RMS 520MC.

G. The trip unit shall have an information system that provides LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip.

H. The trip unit shall be provided with a display panel, including a representation of the time/current curve that will indicate the protection functions. The unit shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.

I. The trip unit shall be provided with a making-current release circuit. The circuit shall be armed for approximately two cycles after breaker closing and shall operate for all peak fault levels above 25 times the ampere value of the rating plug.

J. Trip unit shall have selectable thermal memory for enhanced circuit protection.

K. Protective device coordination shall be provided by the addition of the following individually adjustable time/current curve shaping solid-state elements: All circuit breakers shall have adjustments for long delay pickup and time. Main and Feeder Breakers shall have individual adjustments for short delay pickup and time, and include I^2t settings.

L. Main and Feeder breakers shall have an adjustable instantaneous pickup

M. All circuit breakers shall have individually adjustable ground fault current pickup and time, and include I^2t settings or ground alarm only

N. The trip unit shall have provisions for a single test kit to test each of the trip functions.

O. The trip unit shall provide zone interlocking for the short-time delay and ground fault delay trip functions for improved system coordination. The zone interlocking

system shall restrain the tripping of an upstream breaker and allow the breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after a preset time delay. Factory shall wire for zone interlocking for the power circuit breakers within the switchgear.

P. The trip unit shall have an information system that utilizes battery backup LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A test pushbutton shall energize a LED to indicate the battery status.

Q. All circuit breakers shall have individually adjustable ground fault alarm only.

R. The trip unit shall have a 4-character LCD display showing phase, neutral, and ground current. The accuracy of these readings shall be +/- 2% of full scale.

S. The trip unit shall be equipped to permit communication via a network twisted pair to the LAN system provided in the equipment for remote monitoring and control. All monitored parameters shall be transmitted.

T. The trip unit shall be provided with an Arcflash Reduction Maintenance System Technology capability. The Arcflash Reduction Maintenance System shall allow the operator to enable a maintenance mode using a 5 position switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. A blue LED on the trip unit shall indicate the trip unit is in the maintenance mode.

U. Distribution circuit breakers shall be 80 percent rated, group mounted with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Each breaker shall have a circuit cardholder and neatly printed card identifying the circuit. Tripped indication shall be clearly shown by the breaker handle taking a position between ON and OFF. The entire switchboard shall be manufactured by Eaton/Cutler Hammer or General Electric.

V. Distribution circuit breakers shall electronic trip type with instantaneous, long and short delay, ground fault and arc-flash protection. These circuit breakers shall have true RMS sensing for increased reliability. Each circuit breaker shall have an Ir switch to eliminate the need for rating plugs, Long Delay setting (I2t) setting with variable times, Long, Short, Instantaneous and Ground Fault protection and zone selective interlock from 15-amps to 2500-amps.

W. Each circuit breaker shall have an arc-flash reduction maintenance system along with a High Load alarm, Ground Fault alarm and Cause of Trip indication.

X. The mains switchboard section shall be equipped with a panel mounted digital ammeter, volt meter, power consumption meter, and cause of trip LED indicator.

Y. The switchboard shall be provided with bussed pull section rated at 2,500-amps and is a minimum of 36” wide. The bus bars in the pull section shall carry the rating to the switchboard sections mentioned above.

Z. Each molded case circuit breaker microprocessor-based tripping system shall consist of three (3) current sensors, a trip unit and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors, and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached. The trip unit shall be Eaton type 0, Digitrip 310+ or approved equal.

AA. An adjustable trip setting dial mounted on the front of the trip unit, or interchangeable ratings plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be fixed or adjustable as indicated. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.

BB. System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:

CC. Adjustable long-time setting (set by adjusting the trip setting dial or rating plug)

DD. Adjustable short-time setting and delay with selective curve shaping

EE. Adjustable instantaneous setting

FF. Adjustable ground fault setting and delay

GG. The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.

HH. When the adjustable instantaneous setting is omitted, the trip unit shall be provided with an instantaneous override.

II. Where internal ground fault protection is specified, adjustable settings shall not exceed 1200 amperes. Provide neutral ground fault sensor for four-wire loads.

JJ. Breakers shall have built-in test points for testing the long-time delay, instantaneous, and ground fault functions of the breaker by means of a test set. Provide one test set capable of testing all breakers 225-ampere frame and above.

KK. Provide an ammeter display, Eaton DigiView or approved equal. The metering module shall display load current, and after a fault shall indicate the cause of trip.

LL. Trip units shall include zone interlocking capability for the short-time delay and ground fault delay trip functions for improved system coordination. The zone interlocking system shall restrain the tripping of an upstream circuit breaker and allow the circuit breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after the pre-set time delay. Factory wire zone interlocking system for breakers within each assembly.

MM. 20% spare circuit breaker shall be installed within each switchboard section. Each spare circuit breaker frame shall be 200-amps minimum.

NN. The electrical contractor shall be responsible for a complete coordination study to properly set all adjustable settings on circuit breakers. A copy of the coordination study shall be submitted to the engineer and the owner as part of the as-built drawings.

OO. The switchboard and all panelboards shall be manufactured by the same manufacturer. The switchboard and panelboards shall be manufactured by Eaton Cutlet/Hammer.

PP. The utility metering configuration shall be coordinated with a representative from the local utility company.

2.27 MOTOR WIRING

A. The Contractor shall do all wiring required for plumbing, ventilating and heating motors including mounting of switches and starters, as well as wiring of same. All wiring for the control of motors unless indicated on Electrical Plan, shall be provided under HVAC, Plumbing and Fire Protection.

B. The Contractor shall furnish and install horsepower rated disconnecting means as required by the National Electrical Code for all motors. Motor-driven equipment specified under “Plumbing” and “Heating and Ventilating” may be factory wired complete with controller and motor disconnects; the Contractor shall coordinate equipment purchased under these divisions so as to provide any necessary equipment. Motor disconnects shall be unfused unless noted otherwise. Single-phase motor disconnects may be a thermal switch.

C. Each disconnect shall be clearly labeled with a screw fastened ¼” engraved nameplate stating load controlled.

2.28 MOTOR STARTERS AND CONTROLS

A. Motors will be furnished and installed under the respective Sections of the Specifications under which the equipment is specified.
B. Motors ½ hp and larger will be 3 phase, 60 Hertz; motors less than ½ hp will be 120 volts, single, 60 Hertz, except specifically noted equipment.
C. All motor starters and controls unless furnished as an integral part of the equipment, shall be provided with suitable metal enclosures and shall conform to the NEMA Industrial Control Standards.
D. All motor starters shall have individual running overcurrent protection in each phase and shall be provided with two sets of auxiliary contacts. Starters for single phase motors shall be 2-pole and for 3 phase motors shall be 3-pole.
E. Manual starters shall be of the toggle mechanism type for full voltage starting. Magnetic starters shall be across-the-line type, minimum size NEMA 1 equipped with Hand-Off-Automatic switch.
F. Each motor starter and each control station shall be clearly labeled with screw fastened ¼" engraved nameplate stating equipment controlled.
G. All motor starters shall be furnished by the mechanical contractor.

2.29 PRIMARY DISTRIBUTION SYSTEM

A. Furnish and install all conduit, as indicated on the Drawings. Excavation, backfilling, and concrete work for duct banks and manholes shall be furnished under another Section of the Specification.
B. Underground conduit encased in concrete shall be Schedule 40 Polyvinyl Chloride (PVC) conduit, or approved equal, unless otherwise noted on Drawings. Where PVC conduit is connected to galvanized rigid steel conduit, approved adapters shall be utilized.
C. Conduits shall be secured in duct bank with approved spacers and fastening methods to assure no movement during concrete pour.
D. All Power, Telephone/Data and Cable Television manholes indicated on the drawings shall be constructed of pre-cast concrete with grounding terminal and pig tails for connecting to ground rods.
E. Primary cable shall be 15KV rated, 1/0 aluminum, 1330% rated with a fully jacketed concentric neutral as manufactured by Okonite Cable.
F. Primary load break elbows shall be 15KV, 200-amp rated as manufactured by Cooper or equal.

2.30 SECONDARY ELECTRICAL SERVICE

A. Secondary electrical service shall commence at a secondary connection of the pad mounted transformer. Primary and Secondary connections shall be the responsibility of this contractor unless otherwise indicated by the local utility company.
B. Electrical Contractor shall furnish and install conduit, wire, compression connectors from the secondary spades at transformer to main circuit breaker in the main switchboard. Sizes of which shall be indicated on the Drawings.
C. Electrical Contractor shall furnish and install a concrete envelope around the secondary conduits as indicated on the drawings. The primary and secondary duct bank assembly shall be buried a minimum of 36 inches below the finished grade and each duct bank section shall have a yellow warning tape run the entire length of the respective duct bank. Backfill in trenches shall be select material with no stone or rock larger than a ½" in diameter.

2.31 NAMEPLATES

A. Nameplates shall be furnished and installed on all panelboards, pull boxes, cabinets, for all special purpose switches, motor disconnect switches, remote control stations, motor starters and other controls furnished under this Contract, to designate the equipment controlled and function. Nameplates shall be laminated black bakelite

with ¼ inch high white recessed letters. Nameplates shall be securely attached to the equipment with galvanized screws or rivets.

2.32 SUPPLEMENTARY STEEL, CHANNEL, AND SUPPORTS

A. The Electrical Contractor shall furnish and install all supplementary steel, channels, and supports required for the proper installation, mounting and support of all lighting fixtures and electrical equipment, to be installed under this Contract, as required.

B. All supplementary steel, channels, and supports shall be furnished, installed, and secured with all fittings, support rods, and appurtenances required for a complete support mounting system.

C. The type and size of the supporting channels and supplementary steel shall be determined by the Electrical Contractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with requirement for loading.

D. All supplementary steel and channels shall be installed in the neat and workmanship manner parallel to the walls, floor, and ceiling construction. All turns shall be made with 90 degree and 45 degree fittings, as required to suit the construction and installation conditions.

2.33 VOICE/DATA UNDERGROUND CONDUIT SYSTEM

A. Furnish and install all conduits as indicated on the Drawings. Excavation and backfilling shall be furnished under another section of this Specification. The voice/data duct bank assembly shall be buried a minimum of 36 inches below the finished grade and shall have a yellow warning tape run the entire length. Backfill in trenches shall be select material with no stone or rock larger than a ½" in diameter.

B. Lay conduits in trenches in true alignment and sloped for drainage. All conduits shall slope away from the building.

C. Materials: Schedule 40 PVC conduit as manufactured by Carlon, in 10' lengths, including all couplings and appurtenances necessary for laying in complete conduit line.

2.34 VOICE/DATA SYSTEM

A. Voice over Internet Protocol (VoIP) digital phone service will be utilized as part of this building fit-out. The system shall have the capability of making regular telephone calls over a broadband high speed internet telephone service.

B. VoIP and data service shall originate from the adjacent buildings tel/data closet as indicated on the drawings. The electrical contractor shall coordinate with the staff IT representative, the exact quantity and type of fiber optic cables and copper back bone cables shall be brought to the new facility.

C. Backboards for VoIP equipment shall be furnished and installed by the General Contractor. Main backboard shall be as dimensioned on the Plans. All backboards shall be painted black on both sides with fire resistant paint.

D. The electrical subcontractor shall be responsible for extending the voice/data services to the satellite electric closets as indicated on the drawings.

E. The electrical subcontractor shall furnish and install the service conduit that feeds the building.

F. All backboards shall be furnished with a ground bar with an insulated stand-off secured to the backboard. A #6 bare copper ground conductor shall be bolted to the ground bar with a two hole high compression connector on one end of the cable and the other end of the cable shall be connected to a piece of bare building steel with an approved connector. The ground bar shall be capable of handling at least 12 subordinate connections

G. The electrical subcontractor shall furnish and install all equipment to the Main Backboard. The Electrical Contractor shall furnish all conduit and sleeves where required. The Electrical Contractor shall furnish and install all VoIP outlets and all wiring indicated below.

H. VoIP system wiring and devices shall be as follows:

1. VoIP wiring shall originate from outlets indicated on the drawings and homerun to the either the main backboard or a satellite electric closet as indicated. Wiring for single VoIP outlets shall consist of CAT6 for Blue Colored Cable and for dual data jacks White Colored Cable and Blue Colored Cable to each outlet. Cables shall terminate at a flush mounted, single or dual port modular RJ-45 jacks. Exact jack type shall conform to the requirements as indicated on the drawings and as specified herein.
2. All work shall be performed in accordance with the following codes and industry standards, unless noted otherwise:
    a. NFPA 70 – National Electrical Code, current version adopted by local or State AHJ.
    b. TIA/EIA-568-B, Commercial Building Telecommunications Cabling Standard, current version.
    c. TIA/EIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces, current version.
    d. TIA/EIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure, current version.
    e. J-STD-607-A, Commercial Building Grounding and Bonding Requirements for Telecommunications, current version.
    f. IEEE 241, Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to communication systems.
3. 100 ohm, Category 6 24AWG, 4-pair unshielded twisted pair, LANmark 1000, CMR rated, color blue, Ber-Tek part number 10032455.
    a. Maximum insertion loss of 2.0 dB/100M at 1 MHz, 19.7 dB/100M at 100 MHz, 32.6 dB/100M at 250 MHz and 48.6 dB/100M at 500 MHz.
    b. NEXT, PSNEXT, ELFEXT, PSELFEXT margin greater than 5 dB better than ANSI/TIA/EIA category 6 standards requirement
    c. Cable balance: LCL/TCL greater than 50 dB @ 100 m at 1 MHz, 30.0 dB @ 100m at 100 MHz and 26.0 dB @ 250 MHz. EL TCTL greater than 30 dB @ 100m at 1 MHz, and 5.5 dB @ 100m at 31.25 MHz
    d. Electrical characteristics must be characterized to 550 MHz.
    e. Cable must be third party verified by ETL.
    f. Berk-Tek LANmark-1000
4. Category 6 modular jacks (NetClear GT 3 & GT 2)
    a. 8-position modular jack, Category 6, IDC terminals, T568A/B wiring scheme
    b. Each jack must be stamped or have icons to identify it as CAT 6.
    c. Color to be coordinated with building finishes and all jacks shall be Ortronics OR-TJ600
    d. One port TracJack faceplate, constructed from high impact thermo-plastic, with recessed label fields, mounts within a single gang wall box. Ortronics #OR-40300549.
    e. Two port faceplate, constructed from high impact thermo-plastic, with recessed label fields, mounts within a single gang wall box. Ortronics OR-40300548.
5. The electrical contractor shall furnish separate and distinct 48-port patch panels for the single and dual port cables as indicated on the drawings. Exact quantity of patch panels shall be determined by the contractor.
    a. 48 port, 8-position modular jack panel, high density, 8 port modules, Category 6, IDC terminals, T568A/B wiring scheme. Ortronics # OR-PHAD68U48.

6. Category 6 modular patch cords shall be factory terminated double ended, 8-position to 8-position, modular, stranded conductors, Category 6, 4 pair, color blue.
    a. Ortronics #OR-MC603-06 (3-feet)
    b. Ortronics #OR-MC605-06 (5-feet)
    c. Ortronics #OR-MC607-06 (7-feet)
    d. Ortronics #OR-MC609-06 (9-feet)
    e. Ortronics #OR-MC615-06 (15-feet)
    f. Ortronics #OR-MC625-06 (25-feet)

I. The electrical contractor shall utilize either a J-hook or trapeze system to support cable bundles for all horizontal cables. The cable bundles shall be supported at a maximum of 48 to 60 inch intervals. At no point shall cables rest on acoustic ceiling grids, plumbing pipes, and electrical conduits.

J. Horizontal distribution cables shall be bundled in groups of no more than the amount of cables designed for by the cable support manufacturer recommends based on cable OD and weight... Cables shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

K. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.

L. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.

M. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.

N. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.

O. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.

P. Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable. Separation from Power Lines:

Q. Provide a minimum of 12” separation distances between pathways for copper communications cables and power wiring and fluorescent lighting.

R. Cables shall be coiled to house the cable coil without exceeding the manufacturers bend radius. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. No more than 12” of UTP slack shall be stored. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.

S. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B.1 document, manufacturer's recommendations and best industry practices.

T. All 4 pair cables shall be terminated on the jack and/or patch panels using T568-B or T568-A wiring scheme.

U. Pair untwist at the termination shall not exceed one-half inch.

V. The cable jacket shall be maintained to within one inch of the termination point.

W. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

X. All horizontal cables are to be labeled using a machine printed label at each end of the cable at approximately 12 inches of the termination point, and again at approximately 48 inches from the termination point. Handwritten labels shall not be used.

Y. All patch panel ports and Outlet ports shall be labeled with the cable identifier.

Z. The labels shall denote the Outlet ID, as well as the unique cable number for that Outlet, i.e. A-001-A for cable number 1, A-001-B for cable number 2, and so forth. Owner may provide specific labeling requirements, this contractor shall coordinate with owner's representative for exact labeling configurations.

AA. Note all labeling information on the as-built drawings.

BB. All equipment racks indicated on the drawings shall be furnishaed and installed by this contractor and shall be as follows; 7 foot high, 19 inches wide, rail-to-rail depth shall be adjustable from 6 to 32 inches. Each unit shall be EIA four post equipment rack, UL listed, with universal 5/8 inch x 5/8 inch x ½ inch hole pattern with EIA square hole rails, #12-24 cage nuts and screws, black finish and shall be Ortronics Mighty Mo Server Rack #OR-MM67SVR.

CC. Free-standing equipment racks shall be fastened to the floor using a minimum of four 3/8 inch concrete anchors.

DD. Equipment racks shall be positioned according to drawings with a minimum of 3 feet clearance in front and back. The contractor shall field verify the dimensions of the room prior to installation of racks and report any discrepancies to the engineer prior to installation.

EE. Install cable tray as shown in drawing package, but as a minimum cable tray shall be installed the entire length of each data room and extend 24" beyond the room above ceilings. The locations shown may need to be adjusted slightly in the field to assure proper placement.

FF. All tray sections shall be field cut to length as required with a minimum number of splice points. All field cuts shall be made using the manufacturers recommended equipment.

GG. All wire basket cable tray's shall be supported from the building structure using threaded rod and FAS type supports and shall be bonded to ground and shall be a minimum of 24 inches wide, 4 inches deep, 10 foot lengths, steel construction. Cablofil #105/600EZ

HH. Cable exit manager shall be Cablofil #CABLEXIT, Cable tray to wall termination angle shall be Cablofil #HB2, Cable tray to wall mounting bracket shall be Cablofil #CPR400 and Cable tray splice kit shall be Cablofil #EDRN.

2.35 ACCESS CONTROL SYSTEM

A. Provide Access Control and Alarm Monitoring System as specified herein. All Proximity Readers and alarm points in the building shall be monitored at the main office computer head end.

B. The system shall consist of a multi-drop RS-485 communication with the master controller located in the main tel/data room. A single twisted pair of #24 AWG (Beldon 9501) can be used up to 16,000 feet to connect slave controllers.

C. Each exterior door shall be provided with access control and monitoring as described below.

D. Provide complete contract maintenance service through a factory approved (i.e., factory supervised, trained and equipped) local service shop. Such service shall include: Routine preventative maintenance and periodic checks on equipment performance.

E. Provide dual reader controllers that can support all major reader technologies and 12-digit ABA card formats.

F. Controllers shall utilize "distributed" database technology for independent operation.

G. Controllers shall operate in local or remote site configuration and dial-up or leased line.

H. 750 users and 250 events.

I. Expandable to 8 doors on 2 ports

J. 4 alarm inputs, 4 relay outputs (DPDT)

K. 64 Time zones control card access, Relays, and Alarm Points.

L. Relays are "Time-Programmable" for automatic control.

M. Relays are form "C" contacts rated at 24VDC, 3 Volt/Amps.

N. Anti-passback feature

O. Controllers shall be Keri Systems PXL-510 Tiger II w/18vac, 40va transformer, S-4 Suppressor, and battery backup or approved equal. Provide Keri SB-593 Satellite Interface Expansion Board.
P. Pro series readers use an advanced signal processing technique to communicate with proximity cards.
Q. All proximity readers shall operate on low power consumption for extended reader operation.
R. Card readers shall be designed to provide protection from reader tampering.
S. All card readers shall be rated for Indoor/Outdoor use and protect from harsh environments.
T. The card readers shall operate from a range of 12" from reader face or as shown on drawings.
U. Card Readers shall be Keri PSM-2 or approved equal.
V. Provide wall, doorframe, or ceiling mounted exit PIR's at each door.
W. Provide a PIR unit with built-in sounder for door position monitoring.
X. PIR shall have dual relay outputs.
Y. PIR shall have an adjustable range.
Z. PIR shall be provided with an attractive housing.
AA. PIR shall be tied to the access control controllers.
BB. PIR shall have a separate relay to monitor the door contact for door position.
CC. PIR shall have 4 programmable latch times from 5 to 120 seconds.
DD. PIR External over drive input to allow a remote pushbutton to unlock doors.
EE. PIR shall be Sentrol RTE-1000 or approved equal.
FF. Provide surface wide gap contacts at each door indicated.
GG. Contacts shall have mounting brackets shall be provided with each unit.
HH. Contacts shall be SPDT version.
II. Provide armored cable leads with each unit set of contacts.
JJ. Contacts shall be Sentrol 25O7AH or approved equal
KK. Exterior Siren/Beacon

1. Indoor/Outdoor self-contained armored siren/strobe combination.
2. 122dB sound output
3. 15 Watt armored siren
4. Warble sound output
5. Rust –free aluminum die-cast housing
6. 60,000 candle power strobe
7. Dual-action reed tamper switch
8. Polarized 12VDC input with reverse polarity protection

Provide Amseco SSX-51SB Siren/Strobe or approved equal

LL. Supply all conduit, wire, etc. required for installation and needed to provide a completed, usable security system to the extent such items are not detailed elsewhere in the drawings and the specification.
MM. Contractor shall coordinate final location of all equipment with the Architect and Owner prior to installation.

2.36 CCTV SYSTEM (section removed)

2.37 ADDRESSABLE/ANALOG FIRE ALARM SYSTEM

A. General Requirements:
1. Comply with Division1, General Requirements and documents referred to therein.
2. Provide all labor, equipment, and materials to complete the Life Safety Fire Alarm System work in accordance with local and State Regulations.
3. Fire alarm system and components shall be listed to U.L. standard 864, 9th Edition and Manufactured by Gamewell Company.

B. Description of System:
1. The Life Safety Fire Alarm System shall be an addressable, non-coded, electronically supervised, microprocessor based, voice evacuation system. It shall be complete with all necessary hardware, software and memory specifically tailored for this installation. It shall be possible to permanently modify the software on site by using an integral service console or with a personal computer and specific system software.
2. The fire alarm control panel shall be installed in the main lobby. New addressable Signaling Line Circuits (SLC) will emanate from this panel to all the floors and new initiating devices as indicated on the drawings.
3. Provide smoke and fire detection, sprinkler supervision, and automated single stage evacuation control. Interface to environmental controls and auxiliary devices.
4. Provide signal appliances and signal controls for the safe and orderly evacuation of the building.
5. The Life Safety System shall generally consist of the following main components:
   a. control panel with 24/10 batteries
   b. addressable devices
   c. supervisory relays for sprinkler devices, etc.
   d. auxiliary devices for door holders, access control, etc.
   e. audio/visual devices
   f. LCD type annunciator
   g. framed graphic plan
   h. exterior beacon
   i. exterior sprinkler bell
   j. bi-directional antenna
   k. emergency generator run light

6. Locate the main components and all related devices in the main lobby as shown on the Plans.

C. Bi-Directional Antenna (BDA) system
1. This contractor shall be responsible for coordinating with the Fire Department a radio test that shall determine the signal reception at several locations on each floor. Clear signal strength shall be required throughout the building utilizing the type of hand held radio unit used by the local fire department. Quantity of test locations shall be determined and conducted by a fire department representative. The minimum test points shall be determined by the following equation; (floor square footage / 25,000 sq.ft.) x 2. Additional specific test points may need to be considered in areas containing special wall construction or a large quantity of electromechanical building system equipment.
2. Signal strength testing shall follow TXB-88 standards using Delivered Audio Quality (DAQ) measurements.
3. A minimum signal strength of -95dBm (DAQ4) shall be available over 95% of each floor area requiring coverage when transmitted from the fire department.
4. A minimum signal strength of -95dBm (DAQ4) shall be received at the fire department system from over 95% of each floor area requiring coverage.
5. Frequency ranges shall be determined by the local fire department.
6. BDA shall be Amp - TXRX Model 61-89-50-A18, UHF 80dB, 806-869 Bi-directional signal amplifier or approved equal.
7. The amplifier shall be housed in NEMA 4 Weatherproof housing colored fire engine red and marked “Newton Fire Dept. Radio”
8. Above housing shall include a Locking Cabinet keyed alike with the other fire alarm devices and cabinets.
9. Amplifier shall be complete with DC Power Revert and back up battery & charger
10. TrippLite BP260; TrippLite 98-121; SC-49 Smart Charger

11. Trilogy AT012R50 Riser Rated ½" 50 Ohm Coaxial cable shall be utilized for risers and Trilogy AQ012J50 Plenum Rated ½" 50 Ohm Radiating Coaxial cable for horizontal runs on each floor.
12. Cable connectors shall consist of Trilogy Male/Female connector kits NMP01250 & NFP01250
13. Comprod 362-75 806-960MHz Multi Band Antenna
14. Maxrad MYA8066 800MHz Yagi Antenna
15. The system manufacturer shall provide a wiring diagram and shop drawings of the exact system being proposed prior to any equipment being purchased. All equipment and wiring methods shall be approved by the local fire department and the engineer.
16. Prior to the system being accepted, the contractor shall submit certification that the system is compatible with the local fire department radio system and field tests have been conducted to the satisfaction of the local fire department.

D. Automatic Alarm Operations:

1. Operation of an addressable alarm input device shall flash the alarm signal, and annunciate on the alphanumeric LCD 80-character display. Display the type, condition, and a location message for the first alarm immediately without the need for operator response. Capture the display to annunciate an alarm. In the event the shared display is annunciating when events of a lower priority or the FACP is in the site-programming mode. Turn on a red alarm LED at the control panel.
2. Sort new (subsequent) events by type and log into queues for display by emergency user selection. Sound a momentary audible signal for each event occurrence. Flash a queue LED when an unseen event exists in a queue. Update the display to annunciate the total by type and the chronological number of the event on display i.e. 3 alarm reports - #2 displayed.
3. Activate the new transponder.
4. Sound the evacuation signals throughout the building.
5. Should a fire official choose to operate the Signal Silence button to silence the audio portion of the system, the control panel shall turn on an alarm silenced LED while the signals are in the silence mode. Should a new alarm occur after signal silence, all the alarm devices shall re-sound.
6. Air Handling Unit smoke detectors when activated shall shutdown the respective unit and all associated smoke and fire dampers. The exact location of all remote test stations shall be coordinated with the local fire department.
7. Upon activation of elevator lobby smoke detectors, elevator machine room smoke detectors and/or elevator shaft smoke detectors the respective elevator shall home to the main level. Once the elevators have reached the main level the elevator doors shall open and remain open until the system has been reset. If the main level is in alarm, home the elevators to an alternate floor designated by the local fire department.
8. De-energize door holders to release all fire doors via new control modules at every existing door holder.
9. De-energize all access control systems to allow doors to swing open when freely via new control modules at every location.
10. Elevator machine room and elevator hoistway smoke detectors when activated shall start the hoistway exhaust fan and open the hoist-way louver to ventilate the shaft and shunt-trip power to the elevator circuit breakers.
11. The contractor shall provide a time delay on the main flow switch to allow time for a subsequent flow switch to alarm first and annunciated at the FACP.

E. Non-emergency User Operations:

1. Fire Alarm Control Panel (FACP) shall be equipped with full QWERTY keypad, Acknowledge/Signal, Silence/System, Reset/Drill switches, Automatic time control functions with holiday exceptions and Boolean logic equations.

2. Log a trouble and turn on a System Trouble LED for all user features, which modify, bypass, or inhibit the normal operations of the fire alarm life safety system. Suppress the common trouble signal during delivery of alarm signaling.
3. On the LCD, CPU, operation of the display ID code key shall annunciate the point identification address and description of the currently displayed device.
4. Operation of the menu key shall call a smart prompt program to guide the user through LCD, CPU programming operations. Restrict the use of this program by password.
5. Operation of the Reset/Drill Switch shall return the system to normal after all initiating devices have been returned to normal.

F. Supervisory Operations:
1. Operation of an addressable supervisory input device shall flash the supervisory queue indicator, sound a momentary audible signal, and display on the alphanumeric shared display. Display the type, condition, and a location message for the first alarm immediately without the need for operator response if no fire alarms are present. Log subsequent supervisory events in the supervisory queue for display by emergency user selection. Also, display the current total number of supervisory events and the chronological number of each event. Provide supervisory alarm priority to capture the display from a trouble or monitor event. Turn on a respective amber group individual zone LED at the control panel.
2. Activation of any system connected Carbon Monoxide detectors shall send a supervisory signal to a UL Approved central station monitoring company. The monitoring company shall retransmit the signal to fire department within 90 seconds and to the building manager.

G. Quality Assurance:
1. Install in accordance with the NFPA and the National Electrical Code.

H. Submittals:
1. Submit Shop Drawings for the control panel, voice evacuation control panel and all devices.
2. Submit custom operational sequences for the emergency communications, peripheral devices and fire alarm controls.
3. Submit pictorials or photographs of control equipment overviews, modular components, and interconnecting cable charts.
4. Provide system manuals, maintenance instructions and the name, address, and 24-hour telephone number of the service department of the SYSTEM SUPPLIER.
5. The Electrical Contractor shall provide as-built floor plans showing all devices, control panel, and connections to mechanical equipment. Drawings shall show all conduit routing and sizes, all wire sizes, types, and numbers.

I. Replacement of Defective Items:
1. Supply to the Architect a written agreement from the equipment manufacturer to supply new components to replace defective items without cost to the Contractor, where such defective items become evident during a period of one year from the approved certificate of completing.

J. Transponder:
1. Provide a Gamewell Multiplex transponder in each building to connect into the exiting campus loop.
2. Transponder shall be UL listed on NFPA 72 A, B, C, standards.
3. Program the transponders to operate upon activation of an alarm, OR supervisory condition.

K. Control Center:

1. The fire alarm control panel shall be in accordance with U.L. and N.F.P.A. requirements and be manufactured by Gamewell.
2. The system shall be housed in a surface wall mounted cabinet with a door and viewing windows as required. All annunciator indications, operating controls and instructions shall be clearly visible through the viewing window. The door shall be complete with a lock and two keys.
3. All electrical connections shall be front accessible through the hinged inner door.
4. The service console shall provide system activity LED's and event buffer display.
5. The single person installation verification test shall allow silent and non-silent testing of all system components. In addition, it shall produce a detailed report listing relay and signal programming for each verified input.
6. Provide the ability to field program on the panel or with the use of a personal computer equipped with system specific software. The software shall allow a qualified service technician to perform multiple level programming, detailed system diagnostics and print system summary reports. The FACP shall have an 80 column printer interface and two (2) USB ports.
7. Control panel shall be provided with a Radio Frequency shield to prevent interference and/or failure when firefighting personal key two way radios when in close proximity to the FACP.

L. Signaling Line Circuits

1. Provide the quantity of Signaling Line Circuits (SLC), style 4, 6 or 7 as indicated on the drawings. Each SLC shall be capable of monitoring 159 detectors (any combination of; ionization, photoelectric, thermal or multi-sensor devices) and 159 addressable modules (pull stations, normally open contact devices, two-wire smoke detectors, notification appliances, or relays) per SLC. 318 devices per loop, 3,180 devices per FACP.
2. Connect SLC's to a Loop Controller. Use solid, twisted pair, type FPLP wire in a metallic sheath with a red stripe. Connect SLC's, Class A style. Class B wiring shall not be acceptable.
3. Each SLC shall have a ground fault LED in the FACP to monitor the circuits for ground faults.
4. Each addressable device shall have a unique address. The manufacturer shall program each address and correlate them to output operations per the Plans and this Specification. Non-functioning, non-addressed and non-programmed devices shall report trouble. FACP shall provide for site modification to the addressable programming. The system shall provide for removal of devices without the necessity of re-addressing any other devices. Provide installation flexibility to the contractor by insuring that the physical sequence (placement) of the devices on the loop need not determine the device address.
5. Address and connect, addressable alarm receiving devices to the addressable loop as recommended by the manufacturer. Devices on each SLC shall be polled in less than two seconds and activate in less than five seconds. The manufacturer shall provide installation tables to identify all device addresses.
6. Connect each normally open sprinkler supervisory device to a dedicated addressable transponder. Annunciate each supervisory addressable input device alarm or trouble operations on the LCD. Provide an individual status description on the LCD for each supervisory device.
7. Provide circuits to monitor auxiliary devices such as smoke dampers and fan operation as shown on the Plans. Annunciate open or shorts as required. Provide an individual status description on the LCD for each circuit and display a message on the LCD.
8. Provide programmable control modules at all the door holder and access control door locations. The control modules shall be wired such that upon activation of

the fire alarm system the power to the door holders and access control equipment will be interrupted to allow the doors to fail safe.

M. Notification Appliance Circuits (NAC):

1. All NAC's shall be wired with power limited, Circuit Integrity (CI), supervised circuits, field programmable for any of the following operations:
   - Audible or Visual signals controlled by signal silence.
   - Audible or Visual signals controlled by system reset.
   - Remote auxiliary devices, which DO or DO NOT operate in the degraded mode. This shall be determined upon field requirements and be selectable during programming.
2. The FACP shall be equipped with a six (6) amp switch mode power supply with four Class A or B, built-in NAC circuits. All audio/visual devices shall be synchronized and field selectable as specified herein.
3. The system manufacturer shall provide, as necessary, auxiliary power supplies. The auxiliary power supplies shall provide power limited, supervised circuits for audio/visual devices. All auxiliary power supplies shall have built-in batteries and a charging circuit. Auxiliary power supplies shall be powered from a 120 volt dedicated, emergency power source. Exact quantity of auxiliary power supplies shall be coordinated with system manufacturer.

N. Auxiliary Relays:

1. Auxiliary relay module shall be provided with four, type "1C" site programmable relays.
2. Provide auxiliary relays with switches and status descriptions on the LCD for control functions as listed in the operations and as shown on the Plans. Relays shall be dust tight with fuse protected contacts rated at 24 VDC/120 VAC, 2.5amps. Inductive at a 35 power factor. Each relay will have a follower LED which verifies operation of the relay.

O. Fire Alarm Common Controls and CPU:

1. Common control/CPU shall be self-configurable and able to map to the display module by I/O module type. It shall have built-in field programmable software capable of being programmed and configured on site using either the built-in service console or a personal computer with system specific software. The computer shall be capable of connecting to the USB ports.
2. Provide a LCD CPU/Common Control Central Processing Unit with a 2 line 80-character LCD display and switches for common control, programming functions and alarm displays.
3. Universal Display modules shall connect to the CPU and provide all point identification and/or control functions.
4. Provide the following indicators: Power ON LED, Signals Silenced LED, Point Disabled LED, System Trouble LED, Supervisory LED, Security LED, Pre-Alarm LED, Fire Alarm LED, NAC #1 LED's, NAC #2 LED's, NAC #3 LED's, NAC#4 LED's, SLC #1 Ground Fault LED, SLC #2 Ground Fault LED and Earth Fault LED.
5. Provide the following keypad switch controls; Ground fault detection Enable/Disable, Disable/Enable switch for back-up alarms for (4) NAC's, Acknowledge/Scroll Display switch, Signal Silence switch, Drill switch, Reset switch and Lamp Test switch.
6. The Liquid Crystal Display (LCD) shall be of the super twist high contrast characters. Provide non-interleaving event display by type sorting input events into queues. Types shall be fire alarm, supervisory alarm, trouble, and monitor. Provide a full alpha numeric 80 character (2 x40) display to support site programming. Initiate a trouble signal if programming input is incomplete.

P. System Supervision:

1. Hardware or software fault detection shall activate the audible and visual trouble indicators. Operation of the silence push shall silence the audible signal, but the LED shall remain on. A new fault shall resound the signal. It shall not be possible to turn off the trouble LED until the system is clear of all faults. The common trouble circuit operation shall be independent of the CPU.

Q. Trouble Reporting:
1. All by-pass conditions such as auxiliary or fire department by-pass.
2. All wiring to all fire alarm devices.
3. Power connections and data transmissions.
4. All control panel hardware for placement.
5. All software routines and all program data for change.
6. All volatile memory for failure.
7. Primary and secondary power.
8. All field wiring for ground faults.
9. Maintain a record in memory of fault events.
10. Identify faults by code to simplify service trouble shooting. Standard system reset shall not erase this record.

R. System Power:
1. Provide primary operating power of 120 Volts A.C. 60 Hz. Use modular no break system power supplies with integral battery chargers capable of recharging within 12 hours.
2. Provide supervised secondary battery power to operate the entire system for 60 hours under normal conditions. At the end of 60 hours, the standby source shall power the system under alarm conditions for 10 minutes.

S. System Protection:
1. Provide high voltage transient protection all circuits. Minimum protection shall be 1000V for alarm receiving, 1500V for signaling, and 2500V for power supplies.
2. Protect sensitive electronics subject to static damage. Installer access to areas with static sensitive parts shall not be necessary.
3. Protect controls and annunciation behind locked doors all keyed alike. Provide door windows to allow viewing of all common controls and system annunciation.

T. Addressable Devices:
1. Provide input devices such as manual stations, smoke detectors, duct smoke detectors and heat detectors with built-in addressable transponders. Set a unique address at each device.
2. For heat detectors with fixed temperature ratings higher than 135 F, provide separately mounted transponders outside of, or away from the high heat areas.
3. Provide separately mounted transponders for other input devices such as:
   - sprinkler flow
   - sprinkler supervisory
   - low pressure switches

U. Flow, Tamper and Pressure Switches:
Provide Monitor modules for all existing Flow, Tamper and Pressure switches for adressability to FACP.
Pressure and Tamper switches shall be wired such that upon activation, a Supervisory signal is sent to Campus Security.

V. Addressable Pull Stations:
1. Manual Fire Alarm Stations shall be non-coded, dual action type pull station. The pull stations shall be capable of being opened without causing an alarm condition. An operated device is when the handle latches in the down position

and the word "ACTIVATED" appears. This is the indication that the station has been operated. Each station shall be equipped with a built-in bicolor LED, which shall be visible through the handle of the station. The LED shall flash during normal operation and shall latch steady, RED when in alarm. Manual stations shall be constructed of molded durable Lexan with a textured finish. Stations shall be suitable for surface mounting on matching back box, or semi-flush mounting a standard single gang box and shall be installed not less than four and one-half feet above the finished floor. Manual stations shall be Underwriters Laboratories Listed. Provide an addressable monitor Modules with each station. Manual station shall comply with ADAAG guidelines for controls and operating mechanisms (Section 4.1.3, 13) and meet ADA requirements for 5 pounds maximum activation force. Each device shall be equipped with a key operated reset. Exact key configuration shall be coordinated with the local fire department.

W. Addressable Photoelectric Smoke Detectors:

1. The Contractor shall install, where indicated on the Plans, plug-in, two-wire intelligent Analog / Addressable Photoelectric type smoke detectors and matching bases. The detectors shall be the self-verification type and have integral analog communications, built-in type identifications, and two blinking LEDs. The LEDs shall blink each time the device is addressed, and shall be continuously illuminated when the detector is in alarm. The addressing switches shall be located in the detector bases which shall be directly connected to an SLC for two-way communication with the FACP. The bases shall accommodate matching ionization and thermal detectors. The bases shall be capable of mounting to outlet or device boxes and have provisions for surface mounting. The detectors shall have a built in test switch and shall be capable of remote testing from the FACP. Devices with addressable switches or settings in the heads shall not be accepted.

X. Addressable Heat Detectors:

1. The Contractor shall install, where indicated on the Plans, plug-in, two-wire intelligent Analog/Addressable fixed temperature heat detectors and matching bases. The detectors shall be continuously monitored to measure any change in their sensitivity due to temperature and have integral analog communications, built-in type identifications, and two blinking LEDs. The LEDs shall blink each time the device is addressed, and shall be continuously illuminated when the detector is in alarm. The addressing switches shall be located in the detector bases which shall be directly connected to an SLC for two-way communication with the FACP. The bases shall accommodate matching smoke detectors. The bases shall be capable of mounting to outlet or device boxes and have provisions for surface mounting. The detectors shall have a built in test switch and shall be capable of remote testing from the FACP. Devices with addressable switches or settings in the heads shall not be accepted.

Y. Signal Appliances:

- Strobe Units

  Use red wedge shaped strobes clearly labeled "FIRE" in white letters. Polarize the strobes for supervised operation. Strobes shall provide a high intensity flashing light for visual signaling. Strobe units shall mount surface or flush as indicated on the plans and mount to a standard 4" x 2 1/8" back box with no extension ring required. Strobe Units shall be synchronized and comply with ADA and be UL approved. All strobe units shall be field selectable on the front of the unit with Multi-Candela settings of 15/30/75/110 candela.

- Signal Horn/Strobes

  The devices shall be comply with all appropriate sections of NFPA 72 and be capable of being wall or ceiling mounted. The NAC circuit wiring shall

terminate at the universal mounting plate. Provide white units clearly labeled "FIRE". Each device shall produce a minimum of 75 Candela with a Xenon Strobe Light and an audible signal that will produce not less than 87 dba sound output. Horn/Strobe devices shall be synchronized and comply with ADA and be UL approved. Mount devices flush or surface as indicated on the plans and mount to a standard 4" x 2 1/8" back box with no extension ring. All horn/strobe units shall be field selectable on the front of the unit with Multi-Candela settings of 15/30/75/110 candela and have at least two (2) selectable horn tones and three (3) decibel settings. The strobe light shall consist of a xenon flash tube and associated lens/reflector system.

Z. Auxiliary Devices:

1. Provide remote control relays connected to supervised auxiliary circuits for control of fans, dampers, door releases, etc. Relay contact rating shall be 5 amperes at 120 VAC resistive or 2.5 amperes at 120 VAC inductive for a .5 power factor.
2. Provide flush wall mounted electromagnetic door holders at all the fire door locations. Holders shall mount to a standard single gang outlet box. Holders shall be rated 24V DC and shall release upon activation of the fire alarm system.
3. Beacon, provide a 24 VDC exterior Weatherproof Beacon constructed with a Lexan lens a heavy duty xenon strobe lamp. Beacon shall be similar to Amsec SL-5 or equal.

AA. Installation:

Install a new Fire Alarm Control Panel as indicated on the drawings. Power to the new FACP shall originate from an emergency life safety panel board.

Install new auxiliary power supplies, complete with battery back-up as indicated on the drawings. Power to the new power supplies shall originate from an emergency life safety panel.

Install new horn/strobe devices throughout the facility including all corridors and common areas as indicated on the drawings. These devices shall be flush mounted at the heights indicated on the drawings. These devices shall be connected to a new NAC circuit with 2/C #14 Shield type CI-FPLP wire.

Install new automatic alarm initiating devices (ie, manual pull stations, smoke detectors, heat detector, flow switches, duct smoke detectors, etc.) as indicated and connect to a SLC. Mounting heights and locations shall be as indicated on the drawings.

Install duct detectors and Remote Test Stations in HVAC equipment as indicated on the drawings. Mount duct smoke detectors at a suitable location in the supply air duct work of units 2000 cfm or greater. In units that are rated 15,000 cfm or greater, duct smoke detectors and remote test stations shall be installed in both the supply and return air streams of the unit. Mounted duct detectors in a readily accessible location for maintenance.

Install audible signal devices as indicated and connect to NAC's. NAC wiring shall be suitable for Class II.

If required, install Bi-Directional Antenna system and all associated wiring, power supplies antennas, etc. for two-way communications between the control panel and the floors.

Connect all new door holders to the fire alarm system such that the designated doors release upon activation of the fire alarm system.

Connect all access control door controllers to the fire alarm system with a new programmable control module. The control module shall be programmed to interrupt

the power to the access control door equipment to allow the respective door to swing open freely.

The electrical Contractor shall furnish and install a GREEN LED in the fire alarm control panel to indicate the Emergency Generator running after transferring to emergency power.

All fire alarm riser cables shall be type “CI” (circuit integrity) cable if run exposed or Metal Clad type “MC” with solid conductors in a two-hour rated shaft or enclosure.

All fire alarm wiring shall be Metal Clad type “MC” with solid conductors. The contractor shall be responsible for the supply and installation of the cable, wire, wire pulling, junction boxes, electrical boxes, and terminal cabinets in accordance with the manufacturer’s recommendations but shall be no smaller than what is indicated on the drawings. The manufacturer shall allow for the necessary amount of onsite assistance for the contractor during the construction period.

BB. Verification and Certification:
The manufacturer shall make an inspection of the Life Safety equipment. The inspection shall include all equipment necessary for the direct operation of the system such as input and output devices. Verify wiring connections to ensure that all equipment meets applicable codes and standards. Verify equipment supplied by the manufacturer has been installed per the manufacturer’s recommendations. Verify the operation of all devices. Verify the wiring to all supervised devices is supervised.

CC. Power-limited fire alarm cable shall be used in power-limited circuits in accordance with Article 760 of ANSI/NFPA 70, "National Electrical Code" (NEC).

DD. Unless a higher temperature rating is marked on the cable, power-limited fire alarm cable is intended for use where operating temperature does not exceed 60°C. The voltage rating shall be 300 Volts.

EE. Power-limited fire alarm cable shall be identified by a marking on the surface of the jacket or on a marker tape under the jacket. This marking shall include one of the following Type designations:

FPLP — Indicates cable intended for use within buildings in ducts or plenums or other spaces used for environmental air in accordance with Section 760.154(A) of the NEC. This cable shall exhibit a maximum peak optical density of 0.5, a maximum average optical density of 0.15, and a maximum flame spread distance of 5 ft when tested per ANSI/NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces."

FPLR — Indicates cable intended for use within buildings in vertical shafts in accordance with Section 760.154(B) of the NEC. The flame propagation height of this cable shall be less than 12 ft when tested per ANSI/UL 1666 "Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts."

Power Limited Fire Alarm Cable — Indicates cable suitable for use within buildings (1) where the cable is enclosed in a raceway, or (2) in non-concealed spaces where the exposed length of cable does not exceed 10 ft, in accordance with Sections 760.154(C)(2) and (3) of the NEC. This cable shall comply with the VW-1 Flame Test requirements in ANSI/UL 1581. Cable marked "sunlight resistant" or "sun res" may be exposed to the direct rays of the sun.

Cable marked **"CI (max voltage 300)"** is suitable for use as circuit integrity cable at the maximum voltage to ground indicated, in accordance with Section 760.179(G) of the NEC.

Cable marked "wet" or "wet location" is suitable for use in wet locations.

FF. All conductor wires and cables for fire alarm circuits shall consist of thoroughly tinned 98 percent conductivity copper.

GG. Wires shall be a minimum of, #14/2 Shielded for the audio/visual circuits and #14 Twisted Pair for initiating circuits. All cables shall be solid conductors, unless otherwise noted or shown on plans.

HH. All wire shall be color-coded.

II. All wire and cable shall be as manufactured by General Cable, Rome Cable, Anaconda, or approved equal.

JJ. Fire alarm cables shall be secured by insulated staples, cable-ties, straps and/or hangers at intervals not to exceed 6'-0' on center and within 12" of every cabinet, box or fitting.

2.38 AUTOMATIC LOAD TRANSFER SWITCHES

A. Automatic transfer switches shall be furnished with full load current rating as indicated on the drawings at 120/208 volts, 3 phase, 4 wire, 60 hertz, A.C. normal and emergency as indicated. The transfer switches shall be capable of switching all classes of load, and shall be rated for continuous duty when installed in a non-ventilated enclosure that is constructed in accordance with Underwriter's Laboratories, Inc., Standard UL-1008.

B. The transfer switches shall be double throw, actuated by a single electrical operator momentarily energized; and connected to the transfer mechanism by a simple overcenter type linkage with a total transfer time not to exceed one-half (1/2) second. The transfer switches shall be capable of transferring successfully in either direction with 70% of rated voltage applied to the switch terminals. The withstand and closing rating shall be no less than 65,000.

C. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in position in both the normal and emergency positions without the use of hooks, latches, magnets or springs; and shall be silver-tungsten alloy protected by arcing contacts, with magnetic blowouts on each pole.

D. The transfer switches shall be equipped with a permanently attached manual operator that is designed to prevent injury to the operating personnel, if the electrical operator should suddenly become energized during manual transfer. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly.

E. Engine starting contacts shall be provided to start the generating plant, if any phase of the normal source drops below 70% of rated voltage, after an adjustable time delay period of three (3) to thirty (30) seconds, to allow for momentary dips. The transfer to emergency as soon as the voltage and frequency have reached 90% of rated voltage. After restoration of normal power on all phase to 90% of rated voltage, an adjustable time delay period of 0-30 minutes shall delay re-transfer to normal power, until it has had time to stabilize. If the emergency power source should fail during the time period, the time delay shall be by-passed, and the switch shall return immediately to the normal source. After the switch has retransferred to normal, the engine generator shall be allowed to operate at no load for an adjustable period of time (0-5 minutes) to allow it to cool before shut down. The transfer switches shall include a test switch to simulate normal power failure, pilot lights on the cabinet door to indicate the switch closed on normal or emergency and four (4) auxiliary contacts on the main shaft; two (2) closed on normal, the other two (2) closed on emergency. The transfer switches shall also be provided with pre-elevator signal contacts, and a 7-day with/without load exerciser.

F. Load transfer switches shall be as manufactured by ONAN.

2.30 EMERGENCY GENERATOR (Outdoor)

A. Furnish and install a complete and operating emergency power and lighting system as specified herein and as indicated on the Drawings.

B. The system shall be arranged to provide automatic and instantaneous emergency lighting upon failure of normal lighting in any of the supervised areas. This system shall meet all Code requirements for emergency lighting.

C. Furnish complete, install, and leave in good running condition, a Cummins #400DFEG, 400 KW diesel, engine driven generating set continuously rated for emergency standby service. The 400 KW rating shall be continuously available during any power outage. The unit shall be as hereinafter described as shown on the Drawings, complete with all controls, attachments, accessories, fuel and exhaust systems.

D. The unit shall be the product of a manufacturer regularly engaged in the production of this type of equipment as manufactured by Cummins.

E. The unit shall meet the latest emission requirements set forth from the EPA.

E. The unit shall be capable of accepting the incoming loads of Automatic Transfer Switches. Shop Drawing Submittal for emergency generator shall include a signed statement from the manufacturer's representative stating that:

(1) Manufacturer's representative has reviewed all loads to be connected to the emergency system.

(2) The submitted emergency generator shall capable of automatically starting and running the loads indicate on the drawings.

F. OPERATION

1. The operation of this unit shall be automatic and upon the closing of a remote starting contact in Automatic Transfer Switch the engine shall start and attain rated voltage and frequency within ten (10) seconds.
2. All necessary accessories shall be provided to assure starting within the time described above under the ambient conditions described herein.
3. Furnish and install all electrical work and equipment required for the proper operation of this system. The General Contractor shall provide the concrete pad for the emergency generator. The Electrical Contractor shall provide weight information, as well as dimensional information of the generator to the General Contractor.

G. ENGINE

1. Engine shall be water-cooled, six cylinder, four cycle, turbocharged industrial type, diesel fueled, with a minimum displacement of 15 liters, and a maximum rated output of at least 630 B.H.P. at a maximum R.P.M. of 1800.
2. Lubrication shall be a full pressure system using an engine driven gear-type lube oil pump with replaceable element full flow lube oil filter. Oil cooler shall be required.
3. Fuel System, Diesel

   The engine fuel system shall include all equipment normally supplied and recommended by the generator set manufacturer for standby generator service.

   The system shall be mounted and piped in the enclosure supplied by the engine generator set supplier.

   The fuel system shall be in compliance with all state and local codes.
4. Governor
   a. The engine shall be equipped with an electronic isochronous governor capable of maintaining the engine speed from no load to full load within .25% of the synchronous speed.
5. Starting System
   a. The engine shall have a 24 V.D.C. starting system with one (1) starting motor and starter solenoid switch.
   b. Batteries - One set of starting batteries with cables and steel battery rack, shall be included, batteries shall be heavy-duty lead acid type, rated 220-ampere hours.
   c. Float type battery charger shall be supplied to maintain the starting batteries at full charge. The charger shall be suitable for wall mounting (or may be mounted in the transfer switch) and shall have a cranking disconnect relay

or current limiting feature. The charger shall be LaMarche. Battery charger shall be prewired to generator terminal strip prior to shipment. Battery charger shall include high and low battery voltage alarm relays for annunciator panel and be LaMarche Model A18-3-24V. Include high and low voltage alarm relay.

d. There shall be a belt drive 45 amp battery-charging alternator with regulator and charge rate ammeter for charging the batteries while the engine is running or the float type battery charger may be arranged to charge the batteries from the normal source when the engine is shut down and from the generator output when the generator is operating. This shall be accomplished by a relay energized from the generator output.

6. Jacket Water Heater
   a. A 1500-watt engine jacket water heater shall be provided to maintain the engine jacket water at a temperature high enough to assure starting the engine and attaining rated voltage and frequency within ten (10) seconds. The jacket water heater shall be of the capacity recommended by the generator set manufacturer to meet the above conditions. Input voltage to the heater shall be 208 volt-1-60HZ factory wired to the panel board built into the generator enclosure.
7. Lubricating Oil Heater
   a. A 300-watt engine lubricating oil heater shall be provided with the same functions as jacket water heater. Input voltage to the heater shall be120 volt-1-60HZ factory wired to the panel board built into the generator enclosure.
8. Alternator Heater
   b. A 150-watt alternator heater shall be provided to limit condensation at the alternator. Input voltage to the heater shall be120 volt-1-60HZ factory wired to the panel board built into the generator enclosure.
9. Engine Cooling System
   a. The engine shall be equipped with a unit mounted radiator cooling system complete with unit mounted radiator, circulating water pump, by-pass thermostat, and radiator belt guards. The radiator shall be supplied to operate in an ambient temperature of 122 degrees F.
   b. The cooling system shall be filled with a 50% solution of ethylene glycol and water.
10. Safety Shutdown
    The engine shall be equipped with safety contacts for:
    a.) low jacket water temperature
    b.) low lube oil pressure
    c.) high jacket water temperature
    d.) overspeed
    e.) overcrank
    f.) high oil temperature
11. Engine Instruments
    The following engine instruments shall be included either in an engine instrument panel or in the digital generator control panel:
    a.) lube oil temperature
    b.) lube oil pressure
    c.) water temperature
    d.) D.C. ammeter
    e.) Frequency Meter
    f.) Tachometer
    g.) Any other instruments considered necessary by the manufacturer shall be included.
12. Exhaust System
    a. A high degree exhaust silencer suitable for hospital type silencing complete with condensate drains shall be supplied of the size recommended by the generator set manufacturer, but in no case less than 3 inches. Silencer shall

be as manufactured by Kettell, Maxim, or Burgess Manning. An octave band center frequently in Hertz data sheet shall accompany all Muffler Shop Drawings. A section of seamless, flexible stainless steel exhaust connection of the size and type recommended by the generator set manufacturer, but in no case less than 3 inches diameter and eighteen (18) inches long. If the engine is Vee type, a single exhaust outlet header shall be supplied.

13. Mounting
    a. The engine and generator shall be close coupled and mounted on a structural steel base designed to maintain proper alignment of the unit.
    b. The unit shall be certified by the manufacturer to be free from any critical torsional vibrations within a range of plus or minus 10% of synchronous speed.
    c. Vibration isolators of the rubber pad type shall be supplied with the unit. The number of isolators shall be as recommended by the generator set manufacturer.
    d. Vibration isolators shall be Korfun MMB Series or equal by Consolidated Kinetics or Vibration Eliminator.
    e. GENERATOR
        a.) Rating – 200 KW, 250 KVA, 0-8 P.F., 3 phase, 60 cycle, 120/208 volts. Tier III certified.
        b.) Type - Revolving field, 4 pole, single bearing, drip-proof.
        c.) Exciter - brushless, direct connected, fully tropicalized, SCR rectifiers, static voltage regulator, Rheostat, excellent motor starting capability. PMG shall be provided with a minimum SKVA of 920.
        d.) Voltage Regulation - Plus or minus 1% of any preset value over the three (3) phase load range. Instantaneous voltage dip or rise when measured with an oscilloscope, will not exceed 20% upon full load application or rejection, and will return to preset value within 0.5 seconds.
        e.) Waveform - Deviation factor of output voltage will not exceed 5% and the value of any individual harmonic will not exceed 2% of the fundamental when operating with an unbalanced load.
        f.) Temperature Rise - Temperature rise of any component will not exceed 105 degree C.
        g.) Rotor-One (1) piece laminations welded and secured to shaft by a key and press fit. Mortisseur windings installed and connected between poles as an aid to parallel operation and improved waveform during unbalanced loads. Field coils machine would on insulated pole body and securely braced. Rotor statically and dynamically balanced.
        h.) Stator-One (1) piece laminations welded together. Stator pressed and welded in a rigid steel frame.
        i.) Bearing-Double sealed ball bearing, lubricated for life.
        j.) Insulation-NEMA Class H insulation.
        k.) Varnish-Three (3) coats modified polyester type will not support fungus growth.
        l.) Cooling-Cast aluminum fan mounted on generator shaft.
    f. Radio Suppression - Radiated or conducted radio interference will not affect normal commercial apparatus.
    g. (Unit Mounted) the engine generator set shall include a combination engine generator digital control panel shock mounted at the generator end of the unit. This unit mounted panel shall include (but not be limited to) the following:
        a.) water temperature gauge
        b.) oil pressure gauge
        c.) D.C. battery charge rate ammeter
        d.) A.C. voltage regulator
        e.) voltage adjusting rheostat

f.) start-stop switch
g.) A.C. voltmeter, 3 ½" diameter, .5 accuracy
h.) A.C. ammeter with current transformers, 3 ½" diameter, .5 accuracy
i.) combination VM-AM phase selector switch
j.) frequency meter/tachometer, digital
k.) elapsed time meter, digital
l.) automatic start-stop control with faulty indicating lights and corresponding safety switches for:
- low oil pressure (prewarn and shutdown)
- overcrank protection (manual reset)
- high water temperature (prewarn and shutdown)
- overspeed
- overcrank
- selector switch - "off, auto, manual" with light for "selector switch off"

h. 100% Rated Manual reset line circuit breakers shall be , (2) 3 pole, 400 amp frame, 400 amp trip, mounted in NEMA I enclosures with an interrupting capacity of 65,000 amps, sym, at 208 volts.
a.) The control shall be designed to start the engine upon a closure of a remote contact, arm all safeties, and shutdown the engine when the remote contact is re-opened.
b.) The control must be manually reset following any fault condition.
c.) Control power shall be from the engine start battery.

H. DERANGEMENT PANEL

1. A flush remote mounted engine generator derangement panel shall be built, tested, and supplied by the generator supplier. The derangement panel shall be located in the maintenance office and monitor, visually and audibly, the following:

- Generating (visual only)
- High water temperature
- Low water temperature
- Low oil pressure
- High oil temperature
- Overspeed
- Overcrank
- Battery charger malfunction
- High fuel level - day tank
- Low fuel level - day tank
- Alarm silenced (visual only)
- Panel mounted alarm
- Alarm on/off switch

I. WEATHERPROOF ENCLOSURE

1. A weatherproof aluminum enclosure (Quiet Site II) shall be provided with all accessories specified herein, mounted, piped, and wired to terminal strips within the enclosure, except for automatic transfer switches. Provide fixed louvers for radiator exhaust and incoming air. Enclosure shall be sound attenuated to achieve 72.0dba at 23 feet.
2. The sheet metal enclosure shall have hinged panel doors and shall have fixed louvers and gasketed seams to insure weatherproof construction. The housing shall utilize E-coat paint process insure no rusting or utilize aluminum, No exceptions will be accepted.

3. Silencer shall be mounted inside the enclosure and the exhaust pipe shall terminate in a suitable "Shanty Cap".

J. FUEL SYSTEM

The generator shall be diesel fired and provided with skid mounted, 24 hour fuel tank.

K. TEST

1. The supplier of the equipment shall provide with no additional charge, any information or supervision required for the proper installation of the equipment. Upon completion of the installation of this unit a test run for four hours shall be conducted by the equipment manufacturer's factory trained serviceman, utilizing load banks to attain full generator rating. At this time adjustments shall be made for correct operation of the equipment and the following readings taken at 15 minute intervals:
   a. Engine jacket water temperature
   b. Generator temperature
   c. Oil pressure
   d. Battery charge rate
   e. A.C. volts
   f. A.C. amps (all legs)
   g. Engine air exhaust temperature
   h. Engine oil temperature
2. The second test shall be made by utilizing available connected load. The supplier of this equipment shall also furnish and install lube oil in the engine and also drain and refill the engine with new lube oil after the engine-generator test has been completed. If the engine-generator test has been completed. If the engine-generator unit should fail this initial test run, as determined by the representative of the Owner, after proper corrective measures have been implemented, replace engine lube oil again after the second test. If any additional tests are required to prove the performance of the engine-generator unit, lube oil shall be replaced after each such test run.
3. Prior to shipment of generator to the job site, conduct 3-hour full load shop test utilizing resistive load to attain full rated load. A written report of this test shall be forwarded to the Engineer for approval prior to shipment. All expenses for these tests shall be carried by the Electrical Subcontractor. Notify Engineer one (1) week prior to shop test. Shop test may be witnessed.

PART 3.00 – EXECUTION

3.01 GENERAL PROVISIONS

A. All locations of equipment and materials are subject to review by the Architect in order to coordinate with field conditions.

3.02 TESTS

A. The right is reserved to conduct acceptance texts of all equipment wiring or any other work furnished under these Drawings and/or Specifications to determine the fulfillment of specific requirements and/or design.

B. The Contractor shall perform all tests, supply all instrumentation, personnel and make all adjustments of equipment and wiring as may be necessary. Insulation resistance readings of all equipment and circuits shall be taken by the Contractor in the presence of the Owner's representative. Megger readings of less resistance than the recommended minimum as called by Section 110-7 of the NEC shall be required or replaced by this Contractor at no cost to the Owner.

3.03 DATA CABLE TEST PROCEDURES

A. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.

B. All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards, the Ortronics procedures and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the engineer for clarification and resolution.

C. Cables, jacks, connecting blocks, and patch panels shall be in there final position with the building energized.

D. All Unshielded Twisted Pair cables shall be tested as follows:

1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using an approved Ortronics certification tester (Fluke or Agilent) for Category 6 performance compliance as specified in ANSI/TIA/EIA-568-B.2-1.
2. Follow the Standards requirements established in ANSI/TIA/EIA-568-B .1, B.2-1.
3. The basic tests required are:

    a. Wire Map
    b. Length (feet)
    c. Insertion Loss (dB) (Formerly Attenuation)
    d. NEXT (Near end crosstalk) (dB)
    e. Return Loss (dB)
    f. ELFEXT (dB)
    g. Propagation Delay (ns)
    h. Delay skew (ns)
    i. PSNEXT (Power sum near-end crosstalk loss) (dB)
    j. PSELFEXT (Power sum equal level far-end crosstalk loss) (dB)

4. All test results shall be provided in the approved certification testers original software format on a CD, with the following minimum information per cable:

    a. Circuit ID
    b. All information from 1.1D.3 above.
    c. Test result, “Pass” or “Fail”
    d. Date and Time of test
    e. Project Name
    f. NVP
    g. Version of software

    Note: No asterisk * will be accepted by Ortronics. These results shall be retested and submitted after a PASS is received.

5. A software copy of the test results, in the original tester software format, shall be provided to the Owner and Ortronics.
6. Contractor shall provide a fully functional version of the tester software for use by the Owner in reviewing the test results.
7. Any failed test results that cannot be remedied through re-termination (as in the case of reversed or split pairs), must be reported in writing to the Owner immediately, along with a copy of the test results.

3.04 GROUNDING

A. The Contractor shall furnish and install all material required for grounding and/or bonding in the building of all equipment, power systems, all as shown on the Drawings and/or specified, as a minimum.
B. Grounding shall conform to NEC Article 250.
C. All data equipment racks, cabinets, enclosures, cable tray, conduits, and patch panels shall be bonded to the Telecommunications Main Grounding Bar (MGB) (one per Telecommunications Room), which shall be bonded to the Telecommunications Main Grounding Bar (TMGB), which shall be grounded to the main electrical ground in the main electrical room. Coordinate exact routing and connection points with the electrical work. All surfaces that are used as a bond shall be filed to bare metal before completing connections.

3.05 INSTALLATION OF WIRING AND CONDUIT

A. In general, all wiring is to be run concealed unless otherwise indicated to be run exposed. Exposed wiring in the mechanical spaces is acceptable.
B. Raceways shall be continuous from outlet to outlet and from outlets to cabinets, junction and pull boxes, and shall enter and be secured to all boxes in such manner that each system shall be electrically continuous from service to all outlets. Terminal of all conduits shall be furnished with double locknuts and bushings.
C. Exposed conduits shall be run parallel to or at right angles to the wall of the buildings, and all bends shall be made with standard ells or bent to not less than the same radius. Horizontal runs of exposed conduits shall be close to ceilings, passing over water or other piping where possible and shall be supported by pipe straps or by other approved means, not more than five feet apart.
D. In no place shall conduit be run within six inches of hot water pipes or appliances, except where crossing is unavoidable, and in that case the conduit shall be kept at least one inch from covering of pipe crossed.
E. Conduits shall be supported on approved types of galvanized wall brackets, ceiling trapeze, strap hangers or pipe straps, secured by means of toggle bolts on hollow masonry, machine screws on metal surfaces or wood screws on wood construction. No nails shall be used as a means of fastening boxes or conduit.
F. In general, no splices or joints will be permitted in feeder cables, and branches shall be spliced at outlets or accessible junction boxes.
G. All splices in wire #6 AWG and smaller shall be standard pig-tail made mechanically tight, then cleaned, and insulated with proper layers and thickness or rubber and friction tape. Wire splicing nuts, Thomas and Betts, Sta-Kon or Minnesota Mining and Manufacturing Co., Scotchlock Type R, may be used subject to approval of the local inspector. Joints, tape and splices in wire #6 AWG and larger shall be taped with approved rubber and friction tapes providing insulation not less than that of the conductor over Burndy Servits or equivalent connectors made by Penn Union or Blackburn.
H. Wire #6 AWG and larger shall be connected to panels and apparatus by means of approved lugs and connectors. Connectors shall be solderless type, sufficiently large to enclose all strands of the conductor and securely fastened.
I. Wiring method shall conform to local wiring inspector. Prior to submitting bid, Contractor shall confirm wiring method to be allowed by local ordinances.

3.06 INSTALLATION OF OUTLET BOXES

A. Outlet boxes shall be of size and type to accommodate structural conditions; size and number of raceways; conductors or cables entering; and device or fixture for which required.
B. Install blank plates on all outlet boxes in which no apparatus is installed, which do not integrally provide a cover for box.
C. Special care should be taken to set all boxes correctly, square and true with the building finish. The edge of the box shall come flush with the building finish. As far

as possible, all wall and switch outlets shall be erected in advance of furring and fireproofing and shall be secured to the building structure or steel by adjustable strap iron supports, which shall be buried.

D. The exact location of all outlets and switches in finished rooms shall be obtained from the Architect and from the scale drawings of interior details and finish. Final correct readjustment shall be made to outlets, if necessary, to give proper centering.

E. The locations given or designated on the Plans for the outlets are subject to notifications. In the case of local wall switches to be set at or near doors, the definite location shall be as established on the side of the door opposite the hinge.

3.07 JUNCTION AND PULL BOXES

A. Junction and pull boxes shall be furnished and installed under this Section of the Specification where indicated on the Drawings and wherever else such a box may be deemed necessary to facilitate the pulling or splicing of wire and cable.

B. All such boxes must be made accessible and shall be built only from the approved detail working Drawings. Conduits shall enter these boxes through tight-fitting clearance holes.

C. The covers of the boxes shall be designed for quick removal. Where junction boxes are required for a splicing box for special recessed fixtures, consult the Architect before installing boxes for these fixtures and determine the exact location of the boxes.

D. Each feeder passing through a pull box shall meet the approval of the Architect. Generally, junction boxes and pull boxes shall not be exposed in finished areas; where necessary, reroute conduits or make other arrangements to meet the approval of the Architect.

E. Outlet, pull and junction boxes shall be properly sealed during the course of construction to prevent the entrance of dirt and foreign materials within same or the raceway system of which it is part. The Electrical Contractor shall provide temporary covers for all open boxes. Paper shall be solidly packed into standard work boxes to prevent the entrance of dirt and foreign materials, in lieu of cover plates if so elected by the Electrical Contractor.

3.08 LIGHT SWITCHES

A. In general, convenience outlet circuits shall be independent of light circuits. In all cases the light switches shall be located opposite hinge side of door, per latest Architectural Drawings

3.09 GENERAL PANEL INFORMATION

A. All panels shall be properly balanced, the circuit numbers on the Plans being a numerical indication rather than any attempt to indicate proper balance.

B. Care shall be taken in the use of a common neutral to make certain that no more than one leg is taken form each phase.

C. Typed directories shall be provided in each panel indicating circuit number and the outlets or items controlled or fed from same.

3.10 MOTOR WIRING

A. The Contractor shall do all wiring required for plumbing, ventilating and heating motors including mounting of switches and starters, as well as wiring of same. All wiring for the control of motors, unless indicated on Electrical Plans, shall be indicated in HVAC, Plumbing and Fire Protection Sections.

B. The Mechanical Contractor shall furnish starters to be installed by the electrical contractor. The electrical contractor shall furnish and install fused disconnecting means as required by the National Electrical Code for all motors. Motor-driven equipment specified under “Plumbing” and “Heating and Ventilating” nay be factory wired complete with controller and motor disconnects; therefore, the

Contractor should check equipment purchased under these divisions so as to avoid duplication of protective and disconnecting means. Motor disconnects shall be fused unless noted otherwise. Single phase disconnects may be thermal switches.

C. The Contractor shall furnish and install a fused disconnect at each HVAC unit. Fusing shall be per manufacturer's recommendation. Prior to wiring HVAC units, Contractor shall review submittals on equipment for electrical characteristics.

3.11 VOICE/DATA CABLING

A. The General Contractor shall furnish and install a fire rated plywood backboard for tel/data equipment as indicated on the drawings.

B. Contractor shall furnish and install incoming raceways to the main tel/data room as indicated on the drawings. The exact location of the conduit system shall be determined in field.

C. Contractor shall furnish and install 400 pair outside plant feeder telephone cable running from the Linnell Hall the main tel/data room of the new facility.

D. Contractor shall furnish and install 18 fiber multi-mode outside plant feeder cable running from Linnell Hall main tel/data room to the main tel/data room of the new facility.

3.12 FIRE ALARM SYSTEM

A. INSTALLATION

1. Fire alarm system shall be wired in accordance with manufacturer's complete Wiring Diagram as submitted with Shop Drawings.
2. Fire alarm cable shall be utilized for wiring system components associated with the data loops.
3. Provide two complete Wiring Diagrams and maintenance manuals to be turned over to Owner. Provide one additional Wiring Diagram and maintenance manual in control panel.
4. Entire system shall be guaranteed for one year after final acceptance.
5. Provide and install the system in accordance with the Plans and Specifications, all applicable codes and the manufacturer's recommendations. All wiring shall be installed in strict compliance with all the provisions of NEC-Article 760 A and C, Power-Limited Fire Protective Signaling Circuits or if required, may be reclassified as non-power limited and wired in accordance with NEC-Article 760 A and B. Upon completion, the Contractor shall so certify in writing to the Owner and General Contractor. All junction box covers shall be painted red and labeled "Fire Alarm". Wiring color code shall be maintained throughout the installation.
6. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate Subcontractors.
7. The Contractor shall clean all dirt and debris from the inside and the outside of the fire alarm equipment after completion of the installation.
8. The manufacturer's authorized representative shall provide onsite supervision of installation.

B. TESTING

1. The completed fire alarm system shall be fully tested in accordance with NFPA-72H by the Contractor. Upon completion of a successful test, the Contractor shall so certify in writing to the Owner and General Contractor.

C. WARRANTY

1. The Contractor shall warrant the completed fire alarm system wiring and equipment to be free form inherent mechanical and electrical defects for a period of one year from the date of first beneficial use.

2. The equipment manufacturer shall make available to the Owner a maintenance contract proposal to provide a minimum of two inspections and tests per year in compliance with NFPA-72H guidelines.

D. GENERAL

1. The work covered by this Section of the Specifications includes the furnishing of all labor, equipment, materials, and performance of all operations in connection with the installation of the Fire Alarm System as shown on the Drawings and as herein specified.
2. The requirements of the conditions of the Contract, Supplementary conditions and General Requirements apply to the work specified in this Section.
3. The complete installation shall conform to the applicable sections of NFPA-72 (A), (B), (C), (D), (E), (F), Local Code Requirements and National Electrical Code with particular attention to Article 760.
4. The work covered by this Section of the Specifications shall be coordinated with the related work as specified elsewhere under the project Specifications.

E. QUALITY ASSURANCE

1. Each and all items of the fire Alarm System shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the "U.L." label. All control equipment shall be listed under UL category UOJZ as a single control unit. Partial listing shall not be acceptable.
2. In addition to the UL-UOJZ requirement mentioned above, the system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC Article 760-23.

3.13 EMERGENCY GENERATOR

A. The Electrical Contractor shall install the Emergency Generator in accordance with the manufacturer's directions.
B. The Electrical Contractor shall verify all clearances, dimensions and weights.
C. The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided. All testing shall be performed with calibrated metering.
D. Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.
E. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
F. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.
G. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.
H. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the

consulting engineer.

I. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

J. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

K. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system.

L. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.

M. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two hour full load (resistive) test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.

N. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

O. The generator set supplier shall issue a test report documenting the results of testing, and including a complete list of all settings in the control system.

P. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

Q. The generator set supplier shall maintain service parts inventory for the entire power system at a central location which is accessible to the service location 24 hours per day, 365 days per year. The inventory shall have a commercial value of $3 million or more. The manufacturer of the generator set shall maintain a central parts inventory to support the supplier, covering all the major components of the power system, including engines, alternators, control systems, paralleling electronics, and power transfer equipment.

R. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical power system replacement parts in the local service location. Service vehicles shall be stocked with critical replacement parts. The service organization shall be on call 24 hours per day, 365 days per year. The service organization shall be physically located within 50 miles of the site.

S. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

3.14 QUIET OPERATION

A. All equipment and material furnished by this Contractor shall operate under all conditions of load without objectionable noise or vibration, which in the opinion of the Architect is objectionable. Where sound or vibration conditions occur, which the Architect considers objectionable, this Contractor shall eliminate same in a manner approved by the Architect.

3.15 RECORD DRAWINGS

A. A set of as-built Record Drawings, consisting of a reproducible set of Architect's Drawings with additional sketches as required, denoting and dimensioning

accurately all changes in elevation location and size of material deviating from the Architect's Drawings, shall be kept concurrently with the progress of the installation. Upon completion of the work, the Contractor shall deliver to the Architect an up-to-date set of these as-built Record Drawings.

3.16 SUPPLEENTARY STEEL, CHANNELS AND SUPPORTS

A. Supplementary steel and channels shall be firmly connected to building construction in a manner approved by the Architect prior to the installation of same. The Electrical Contractor shall submit to the Architect, via the General Contractor the location where he proposes to use supplementary steel and channels, for the support of equipment, fixtures and raceways. The submittal shall indicate the mounting methods, size, and details of the supports, channels and steel. It shall indicate also the weight, which the supports, channels and supplementary steel are to carry.

SECTION 211100 - FIRE PROTECTION

INDEX

SECTION 211100 - FIRE PROTECTION

PART 1 – GENERAL

1.1 REFERENCES

A. All of the Contract Documents, including General and any Supplementary Conditions and Division 1-General Requirements, apply to the work of this section.

B. Examine all Drawings and all other Sections of the specifications for requirements therein affecting the work of this trade.

C. The fire suppression system drawings and hydraulic calculations that are a part of these fire protection documents have been developed and prepared for use in complying with permitting requirements. The installing contractor shall be responsible to prepare shop drawings hydraulic calculations, providing design narrative and to provide all other documentation required to be submitted for review by any Authority Having Jurisdiction, the architect and Registered Professional Engineer that has sealed and signed these documents.

D. This specification requires preparation and submissions of drawings and other documents, procurement of approvals and provision of a complete functional systems of automatic fire protection. As a result, this Section serves dual purposes of providing specifications and indicating design criteria for the Fire Protection Subcontractors use and guidance in preparing sprinkler installation drawings and other documents for approvals.

E. The fire protection work is partially shown on the drawings. Each bidder for work under this Section of the specifications shall establish for himself, the exact quantity of heads and all other materials and equipment required for the project and the exact extent of the work required for the project and the exact extend of the work required by all Authorities Having Jurisdiction. Refer to Architectural reflected ceiling plans for sprinkler head locations. Additional heads shall be provided at no additional cost as part of this Contract, as required, to satisfy the Code requirements.

1.2 DEFINITIONS

A. Words in the singular shall also mean and include the plural, wherever the context so indicates and words in the plural shall mean the singular, wherever the context so indicates.

B. Wherever the terms "shown on drawings" are used in the specifications, they shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.

C. Wherever the term "provide" is used in the specifications it will mean "furnish" and "install", "connect", "apply", "erect", "construct", or similar terms, unless otherwise indicated in the specifications.

D. Wherever the term "material" is used in the specifications it will mean any "product", "equipment", "device", "assembly", or "item" required under the Contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.

E. The terms "approved", or "approval" shall mean the written approval of the Architect.

F. The term "specification" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, including all drawings.

G. The terms "directed", "required", "permitted", "ordered", "designated", "prescribed" and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect. The terms "approved", "acceptable", "satisfactory" and similar words shall mean approved by, acceptable or satisfactory to the Architect. The terms "necessary", "responsible", "proper", "correct" and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.

H. "Piping" includes in addition to pipe or mains, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

I. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.

J. "Exposed" means not installed underground or "concealed" as defined above.

K. "Fire Protection Subcontractor" refers to the Subcontractor or his Subcontractors responsible for furnishing and installation of all work indicated in the Fire Protection specifications and as shown on the fire protection drawings.

L. Owners Insurance Underwriter

1.3 SCOPE

A. Perform work and provide material and equipment as shown on the Fire Protection Drawings and as specified or indicated in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide a complete and fully functional installation.

B. Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

C. Give notices, file plans, obtain permits and licenses, pay fees and obtain necessary approvals from all Authorities Have Jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings and Addenda all of which are part of these Contract Documents.

D. The Scope of the Work consists of the installation of all materials to be furnished under this Section, including all associated work required, and without limiting the generality thereof, to include:

Hydrant flow testing.
Complete automatic sprinkler system including main alarm check valve.
Automatic sprinkler heads (including all heads to be center of tile).
Inspector's test stations, connections and drain risers.
Fire department connections.
Temporary standpipes and fire department valves for emergency use during construction.
Supervisory (Tamper) switches.
Flow switches.
Escutcheons.
Coordination and co-operation.
Catalog cuts, shop drawings and hydraulic calculations verifying pipe sizing.
Connection to new Fire Service 10’-0” beyond building wall.
Double check valve assembly
Core drilling of holes up to and including 12" diameter
Sleeves, caulking and fireproofing of sleeves, inserts and hangers
Staging and planking up to and including 8 feet in height
Testing and certificates
Record drawings - AutoCAD 2010
Operations and Maintenance manuals
Valve tags and charts
Instructions
Spare heads in cabinet, wrenches
Hoisting, rigging, setting of all piping and equipment as outlined in General Conditions
Fees, permits, royalties, guarantees, submittals to and approvals from City of New Haven Fire Department and Owner's Insurance Agent and all other State and Local Authorities exercising jurisdiction over this project.
Pressure gauges at top of each riser
Furnishing of access panels
Drains
Coordination drawings - AutoCAD 2010
Seismic Bracing
Building automation system
Expansion loops

Control and Interlocking wiring
Vibration Isolators
Window Sprinklers at second floor

E. The following work is not included in this Section and is to be performed under other Sections:

1. Cutting and patching Section 017329.
2. Temporary water, facilities and controls Section 0150000.
3. Housekeeping pads, thrust blocks for exterior piping, cutting and patching in concrete:033000
4. Flashing of all pipe penetrations.
5. Finish painting Section 099123.
6. Plumbing 220000.
7. Heating, ventilating and air conditioning work 230000.
8. Electrical power wiring, wiring of tamper and alarm flow switches to building fire alarm system.
9. Installation of access panels furnished under this Section shall be by the Trades as designated by the Construction Manager section 083113.
10. Fire alarm system and controls Section 260000.

1.4 CODES, STANDARDS AND REFERENCES

A. All materials and workmanship shall comply with all latest editions of applicable Codes, Local and State Requirements and requirements of all Authorities having jurisdiction, and these specifications.

B. In case of difference between any Regulations and the Contract Documents, the Fire Protection Subcontractor shall promptly notify the Architect in writing of any such difference.

C. In case of conflict between the Contract Documents and the requirements of any Code or requirements of any Authorities Having Jurisdiction, the most stringent requirements of the aforementioned shall govern. Fire Protection Subcontractor shall promptly notify the Architect in writing of any such occurrence.

D. Should the Fire Protection Subcontractor perform any work that does not comply with the requirements of the specifications and applicable Codes, he shall bear all costs arising in correcting the deficiencies to the satisfaction of the Architect.

E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations and the applicable requirements of the following accepted Codes and Standards, without limiting the number, as follows:

1. Local and State building codes.
2. Maine life safety code
3. National Fire Protection Association (NFPA)
4. Occupational Safety and Health Act (OSHA)
5. Building Owner's Insurance Company
6. Underwriters' Laboratories (UL)
7. International Building Code (IBC)

F. In these specifications, references made to Code are intended to indicate the accepted volume or publication of the Standard or applicable Code. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:

1.	ANSI	American National Standards Institute
2.	ASME	American Society of Mechanical Engineers
3.	ASTM	American Society of Testing Materials
4.	AWS	American Welding Society
5.	CS	Commercial Standards, U.S. Department of Commerce
6.	MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
7.	NEMA	National Electrical Manufacturers Association
8.	UL	Underwriters' Laboratories, Inc.

G. Specific reference is made to the following NFPA codes which shall govern provision of work as specified and as required by codes and authorities.

1. No. 13 Installation of Sprinkler Systems
2. No. 25 Inspection, Testing, and maintenance of water based Fire Protection Systems
3. No. 72 National Fire Alarm Code
4. No. 101 Life Safety Code

H. The Fire Protection Subcontractor for the work shall give all necessary notices, obtain and pay for all permits, pay all taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. The Fire Protection Subcontractor shall obtain all required Certificates of Inspection for his work and deliver same to the Architect before request for acceptance of his portion of work is made and before final payment.

1.5 GUARANTEE

A. Attention is directed to provisions of the General Conditions and Supplementary General Conditions regarding guarantees and warranties for work under this Contract.

B. Manufacturers shall provide their standard guarantees for work under this Contract. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and Construction Manager may have by Law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the Fire Protection systems, as determined by the Architect and shall remain in effect for a period of one (1) year thereafter.

C. All materials, items of equipment and workmanship furnished under each Section shall carry the standard warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the Fire Protection Subcontractor including all other damage done to areas, materials and other systems resulting from this failure.

D. The Fire Protection Subcontractor shall guarantee that all elements of the systems provided under his Contract, are sufficient to meet the specified performance requirements as set forth herein or as indicated.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the Fire Protection Subcontractor within one (1) week at no cost to the Owner.

F. The Fire Protection Subcontractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

G. Provide 24 hour service beginning on the date the project is first occupied, whether or not fully occupied, and lasting until the termination of the guarantee period. Service shall be at not cost to the Owner. Submit name and a phone number that will be answered on a 24 hour basis each day of the week, for the duration of the service.

H. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's satisfaction, advise Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Architect will suggest course of action.

1.6 THE SUBCONTRACTOR

A. The Fire Protection Subcontractor shall study all Contract Documents included under this Contract to determine exactly the extent of work provided under this Section, and in installing new equipment and systems and coordinating the work with the other Trades.

B. The Fire Protection Subcontractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications.

C. The Fire Protection Subcontractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed directly or indirectly by the Fire Protection Subcontractor shall perform their work according to all the conditions as set forth in these specifications.

D. The Fire Protection Subcontractor shall furnish all materials and do all work in accordance with these specifications and any supplementary documents provided by the Architect. The work shall include every item shown on the drawings and/or required by the specifications as interpreted by the Architect. All work and materials furnished and installed shall be new and of the best quality and workmanship. The Fire Protection Subcontractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed.

1.7 COORDINATION OF WORK

A. The Fire Protection Subcontractor shall compare his drawings and specifications with those of other Trades and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the mechanical work. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, Fire Protection Subcontractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the Fire Protection work caused by the Fire Protection Subcontractor's neglect, shall be made by him at his own expense, to the Architect's satisfaction.

B. Locations of pipes and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. The Fire Protection Subcontractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component.

C. Lines which pitch shall have the right-of-way over those which do not pitch. For example, waste piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.

D. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The Fire Protection Subcontractor shall provide manual air vents and drains as required for his work to effect these offsets, transitions and changes in direction. All work shall be installed in a way to permit removal (without damage to other parts) of coils, filters, control appurtenances, fan shafts

and wheels, filters, belt guards, sheaves and drives and all other system components provided under this Contract requiring periodic replacement or maintenance. All piping shall be arranged in a manner to clear the openings of swinging overhead access doors as well as ceiling tiles.

E. The Contract Drawings are diagrammatic only intending to show general runs and locations of piping, equipment, and specialties and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom. All changes required due to job conditions must be approved by the Architect prior to commencement of work.

F. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, flow switches, etc., such conflicts shall be reported to the Architect prior to signing of the Contract. If such action is not taken, the Fire Protection Subcontractor shall furnish such items as part of his work as necessary, for complete and operable systems and equipment, as determined by the Architect.

G. Where drawing details, plans and/or specification requirements are in conflict and where pipe sizes of same pipe run is shown to be different between plans and/or between plans and sections or details, the most stringent requirement will be included in the Contract. Fire Protection systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.

H. Final location of all sprinkler heads, alarms, control devices shall be coordinated with the Architectural reflected ceiling plans and/or other Architectural details, as applicable. Offsets of piping, added sprinkler heads, elbows, etc., shall be provided as required to comply with the architectural reflected ceiling plans. Obtain approval of locations of all devices from Architect in the field. Additional heads, piping, fittings, etc., shall be provided to accomplish the above requirement, as required, all as part of this Contract, at no extra cost to the Owner.

I. Included as part of coordination, this fire protection contractor shall maintain service and maintenance access around all fire protection equipment.

1.8 COORDINATION DRAWINGS

A. Before materials are purchased, fabricated or work is begun, each Subcontractor shall prepare coordination drawings for all floors/areas, including buried systems/services (all-Trade-composite at 3/8 inch scale), showing the size and location of his equipment and lines, in the manner described herein under General Requirements - Section 01040.

B. Coordination drawings are for the architect's use during construction and shall not be construed as shop drawings or as replacing and shop drawings. The coordination drawings, when corrected for actual "as-built" conditions, will be reviewed by the Architect, corrected and become the Record Drawings to be submitted to the Owner for his use.

C. The cost of producing and reproducing the drawings will be included under the Contract of each Trade, including the cost or preparation of the Architectural building outlines. The HVAC Contractor shall take the lead to produce the Architectural backgrounds, show all ductwork, piping, etc., and circulate the drawings to any of his Subcontractors and the other Trades (Plumbing, Fire Protection, Electrical), so that they can indicate all their work as directed by the Architect as required, to result in a fully coordinated installation.

D. In addition to the regular coordination drawing review, the mechanical work will also be reviewed by the Architect/Engineer to ensure that the system and equipment arrangements are suitable to provide maintenance access and service as follows:

1. Valves and instrumentation should be grouped where possible and positioned in accessible locations.

E. Prepare a complete set of computer based AutoCad 2010 drawings at scale not less than 3/8" equals 1'-0", showing basic layout for the structure and other information as needed for preparation of Coordination Drawings. The drawings shall indicate the layout of all specialty tradework as indicated herein and shall be designated as Coordination Drawings. The Contractors can purchase a copy of the floor plans on disk from the engineer to assist in the preparation of Coordination Drawings. The Contractor shall provide a minimum of two (2) weeks notice to the engineer for the preparation of the disk. A signed liability release form will be required from the Contractor prior to the release of the disk from the engineer.

F. Highlight all fire rated partitions on the Coordination Drawings for appropriate coordination.

G. The main paths for the installation or removal of equipment from mechanical and electrical rooms shall be clearly indicated on the Coordination Drawings.

H. Each of the specialty trades shall add its work to the base drawings with appropriate elevations and grid dimensions. Specialty trade information shall be required for fan rooms and mechanical rooms, horizontal exits from duct shafts, crossovers and for spaces in the above ceilings where congestion of work may occur such as corridors and, where required, entire floors. Drawings shall indicate horizontal and vertical dimensions to avoid interference with

structural framing, ceilings, partitions and other services. Indicate elevations relative to finish floor for bottom of ductwork and piping and conduit 6" greater in diameter.

1. Specialty Trade shall include:

    a. Plumbing system.
    b. HVAC piping and equipment
    c. Electrical
    d. Sheet Metal Work
    e. Sprinkler System
    f. ATC system

I. Upon completing their portion of the Coordination Drawings, each specialty trade shall sign, date and return Coordination Drawings to the Contractor.

J. Where conflicts occur with placement of materials of various trades, the General Contractor shall be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialized and dated by the affected specialty trade subcontractor. The General Contractor shall then final date and sign each drawing.

K. Fabrication shall not start until Coordinate Drawings have been distributed to all parties as indicated herein.

L. Format: Coordination Drawings (plans only) shall be done using CAD in AutoCAD, 2010 in either IBM or Mac Format, disks shall be given to the architect for future transfer to Owner. Coordination Drawings will be used as base for as-built drawings.

M. Distribution of Coordination Drawings:

1. The General Contractor shall provide one print of each Coordination Drawing to:

    a. Each specialty trade Subcontractor
    b. Owner
    c. Construction Manager
    d. Architect (for record purposes)

N. After distribution:

1. The method used to resolve interferences not previously identified shall be as in paragraph F. above. Distribute revised Coordination Drawings to all parties listed above.

O. Coordination Drawings include but are not necessarily limited to:

1. Structure
2. Partition/room layout, including indication of smoke and fire resistance rated partitions.

3. Ceiling layout and heights
4. Light fixtures.
5. Access Panels
6. Sheet metal, heating cols, boxes, grilles, diffusers, etc.
7. All heating piping and valves.
8. Smoke and fire dampers.
9. Soil, waste and vent piping.
10. Major water and gases.
11. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit. Motor control centers, starters and disconnects.
12. Sprinkler piping and heads.
13. All equipment, including items in the Contract as well as O.F.C.I. and O.F.I. items.
14. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur indicates areas in which the required access area may be greater than the suspected grid systems.
15. Dental Vacuum & Dental Air System

1.9 GIVING INFORMATION

A. The Fire Protection Subcontractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the Architect and other Subcontractors sufficiently in advance of the work so that all openings may be built in advance.

1.10 EQUIPMENT AND MATERIALS

A. Equipment and materials shall be delivered to the site and stored in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls, switches, etc., shall be stored in dry, heated spaces.

B. The Fire Protection Subcontractor shall have his equipment tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned, polished thoroughly and turned over the Owner in a condition satisfactory to the Architect. Damage or defects developing before acceptance of the work shall be made good at the Fire Protection Subcontractor's expense.

C. The Fire Protection Subcontractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his Trade and shall furnish

and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.

D. The manufacturers listed within this specification have been pre-selected for use on this project. No submittal will be accepted from a manufacturer other than specified. Should the Fire Protection Subcontractor wish to propose a substitution during the bid period, such request shall be made in writing to the Architect, no less than seven (7) working days, prior to bid date. If substitutions are deemed acceptable, such items shall be issued on an Addendum, prior to bid due date. The above requirement is mandatory.

E. Manufacturers' directions shall be followed completely in the delivery, storage, protection and installation of any equipment. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's written instructions before proceeding with the work. Should the Fire Protection Subcontractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.

F. The Fire Protection Subcontractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.

G. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of the Fire Protection Subcontractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, the Fire Protection Subcontractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Fire Protection Subcontractor shall make all necessary changes in all affected related work provided under other Sections including location of roughing in connections by other Trades, electrical requirements, piping, supports, insulation, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.

H. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. Equipment and materials shall be products which will meet with the acceptance of the Authorities having jurisdiction over the work and as specified hereinbefore. Where such acceptance is contingent upon having the products listed or labeled by FM, UL or other testing laboratories, the products shall be so listed or labeled. Where no specific indication as to the type or quality of material or equipment is indicated, a first class standard article shall be provided.

I. All equipment of one type (such as valves, heads, switches, etc.,) shall be the product of one manufacturer, unless otherwise specified.

1.11 CUTTING AND PATCHING

A. All concrete and masonry equipment bases and pads, curbs, chases, pockets and openings required for the proper installation of the work under this Contract will be provided by the General Contractor, using information, as shown on the drawings and/or as required and furnished by the Fire Protection Subcontractor. At a minimum, concrete bases (housekeeping) pads shall be 4 inches high and extending 3 inches on all sides beyond equipment (for all base mounted equipment).

B. In addition to the requirements outlined herein for cutting and patching, the Fire Protection Subcontractor shall be responsible for core drilling all holes required for work under his Contract and with the written approval of the Architect.

C. In no case shall the Fire Protection Subcontractor cut into any structural elements without the written approval of the Architect.

1.12 USE OF PREMISES

A. The Fire Protection Subcontractor shall confine all of his apparatus and storage of materials and construction to the work area or limits as directed by the Architect and he shall not encumber the premises with his materials.

B. In storing materials within areas (structure or ground), or when used as a shop, the Fire Protection Subcontractor shall consult with the Construction Manager and shall restrict his storage to space designated for such purposes. The Fire Protection Subcontractor will be held responsible for repairs, patching or cleaning arising from any unauthorized use of premises.

C. Notwithstanding any approvals or instructions which must be obtained by the Fire Protection Subcontractor from the Architect in connection with use of premises, the responsibility for the safe working conditions at the site shall remain the Fire Protection Subcontractor's and the Architect or Owner shall not be deemed to have any responsibility or liability in connection therewith.

1.13 PROTECTION

A. All materials such as valves, fittings, piping etc., shall be properly protected and all piping openings shall be temporarily closed by the Fire Protection Subcontractor installing same, so to prevent obstruction and damage. To protect the equipment, temporary covers of substantial nature shall be provided to assure that items such as fire department valves, cabinets, etc., are not damaged. The Fire Protection Subcontractor shall take precautions to protect his materials from damage and theft.

B. The Fire Protection Subcontractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or systems provided under his Contract.

1.14 DAMAGE TO OTHER WORK, CORRECTION OF WORK AND EXTRA WORK

A. The Fire Protection Subcontractor shall be held responsible and shall pay for all damages caused by his work to the building structure, equipment, piping, duct systems, etc., and all work and finishes installed under this Contract in the building. Repair of such damage shall be done as herein before specified, at the expense of the Fire Protection Subcontractor and to the Architect's satisfaction.

B. The Fire Protection Subcontractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after completion of work and whether or not fabricated, installed or completed. The Fire Protection Subcontractor shall bear all costs of correcting such rejected work.

C. No claim for extra work will be allowed unless it is authorized by the Architect in writing before commencement of the extra said work.

1.15 PIPE SLEEVES, PLATES AND ESCUTCHEONS, FIRE STOPPING AND SMOKEPROOFING

A. Where pipes pass through all walls or floors, the Fire Protection Subcontractor shall provide and set individual sleeves for each pipe and all other work under his charge, as necessary for passage of all pipes. Sleeves shall be of sufficient size to provide 1/2 inch air space around the pipe passing through it. All openings shall be sealed, smokeproofed and made tight. The Fire Protection Subcontractor shall be responsible for the exact location of sleeves provided under this Contract and shall coordinate all requirements for piping sleeves.

B. The Fire Protection Subcontractor, for work under his charge, shall determine the diameter of each individual wall opening or sleeve before ordering, fabrication or installation.

C. Sleeves and inserts shall not be used in any portions of the building, where their use would impair the strength or construction features of the building. Elimination of sleeves must be approved by the Architect.

D. Provide chrome-plated brass escutcheons with set screw for exposed piping, in all areas. In mechanical rooms use plain brass or cast iron escutcheons suitable for painting. All escutcheons shall be sized to fit the bare pipe or insulation in a snug and neat manner. They shall be of sufficient size to cover sleeved openings for the pipes and of sufficient depth to cover sleeves projecting above floors. Escutcheons shall be as manufactured by Beaton and Caldwell, Dearborn Brass or Grinnell.

E. Exterior wall sleeve through masonry walls shall be made water tight by the use of a Mechanical Seal Joint as manufactured by Century Products Link Seal.

F. Pipe sleeves shall be made of Schedule 40 pipe, 16 gauge galvanized steel or 16 gauge steel as follows:

1. Sleeves on pipes passing through masonry or concrete construction shall be Schedule 40 pipe.

2. Sleeves passing through masonry partitions shall be 16 gauge steel unless required otherwise by item 1. above.3. Sleeves on pipes passing through drywall construction shall be 16 gauge galvanized steel.

3. Sleeves on pipes passing through fire rated drywall partitions shall be 16 gauge steel.

4. Sleeves required on all pipes passing through all walls.

G. Pipe sleeves shall be set as follows:

1. Set sleeves 1 inch above finish floor (6 inches at penthouses and mechanical rooms) and flush on each side of walls, except sleeves through floor occurring in walls and partitions shall terminate flush with finish floor.

2. Sleeves shall be set securely in place before concrete is poured.

H. The Fire Protection Subcontractor shall firestop or smokestop the space between the sleeves provided under his Contract and pipes as applicable, as required by general conditions.

1.16 WATERPROOFING, FLASHING AND COUNTERFLASHING

A. Unless specifically indicated otherwise, the Fire Protection Subcontractor shall provide all counterflashing and waterproofing of all piping, and equipment provided by him, which pierce roofs, walls and other weather barrier surfaces. All work under this paragraph shall be coordinated with the Construction Manager.

B. All work shall be performed in a workmanlike manner to assure weatherproof installation. Any leaks developed due to this Subcontractor's work shall be repaired at his expense, to the Architect's satisfaction.

C. Pipes passing through slabs shall have the sleeve extended above floors as hereinbefore specified to retain any water and the space between the pipe and sleeve caulked with lead wool. The top shall be sealed with lead and the bottom shall be sealed with monolastic caulking compound. The space between the outside of the sleeve and the floor slab shall be caulked watertight sufficiently to hold 2 inches of standing water.

D. All flashing required for piping penetrations shall be provided by the Construction Manager.

1.17 MISCELLANEOUS IRON AND STEEL

A. The Fire Protection Subcontractor shall provide all steel supports and hangers as shown on the drawings and/or required to support all Fire Protection equipment, systems and materials provided under this Contract.

B. All work shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets and framework shall be properly sized and strongly constructed.

C. Measurements shall be taken on the job and worked out to suit adjoining and connecting work. Members shall be straight, true and accurately fitted.

D. Drilling, cutting and fitting shall be done as required to properly install the work and accommodate the work of other Trades as directed by them.

E. Members shall be generally welded except that bolting may be used for field assembly where welding would be impractical.

F. All shop and field fabricated iron and steel work shall be cleaned and dried and given a coat of rust inhibiting paint on all surfaces and in all openings and crevices.

1.18 ELECTRICAL WORK, MOTORS, MOTOR CONTROLLERS

A. All electrical apparatus and controls furnished as a part of the Fire Protection work shall conform to applicable requirements under Electrical Section.

B. The Fire Protection Subcontractor shall provide the Electrical Subcontractor with all electrical requirements within thirty (15) days from date of Contract to allow proper coordination of Trades by the General Contractor.

C. The Fire Protection Subcontractor shall verify with the Electrical Subcontractor available electrical characteristics before ordering any equipment or motors.

1.19 IDENTIFICATION OF MATERIALS

A. All equipment used in the Fire Protection systems shall have a permanently attached nameplate identifying the manufacturer, service, size, serial number or model number, etc. The nameplates shall be kept clean and readable at all times.

B. Each item of equipment not provided with a manufacturer's nameplate, shall be identified by a permanently attached nameplate made of black surface, white core laminated bakelite with 1 inch high indented letters. Nameplates shall be minimum of 5 inches long by 3 inches wide and bear the equipment name as designated in the equipment schedules or the specifications. Nameplates shall be as fabricated by Seton Nameplate Company, Atlantic Engraving Company, W.H. Brady Company or approved equal.

C. A legend showing the service and an arrow indicating the direction of flow shall be applied on each pipe installed by the Fire Protection Subcontractor.

D. The piping shall be identified in the following locations and where directed by the Architect.

1. Pipe mains and branches every 15 feet.
2. At each valve.
3. Each wall penetration (both sides).
4. Each riser including branch risers from mains.
5. At each piece of equipment.

E. The identification of piping shall be coordinated with the Owner. Obtain approval of Architect prior to installation. The letter size and background color shall conform to the ANSI Scheme for the Identification of Piping Systems (ANSI 13 latest amendment).

1.20 VALVE TAGS, NAMEPLATES AND CHARTS

A. All valves on pipes of every description installed by the Fire Protection Subcontractor, shall be provided with neat circular brass valve tags of at least 1 1/2 inches in diameter, attached with brass hook to each valve stem or handle. Tags shall have stamped on, in letters as large as practical, the number of the valve and the service, such as "FP", WSP, DSP, etc., for Fire Protection, wet sprinkler, dry sprinkler. The numbers of each service shall be consecutive. Obtain approval of Architect prior to installation.

B. All numbers utilized shall correspond to numbers indicated for valves on the Record Drawings and on two (2) printed detailed lists. These printed lists shall state the numbers and locations of each valve and the equipment or system which it controls and other necessary information such as requiring the opening or closing of another valve or valves when any one valve is to be opened and closed.

C. These printed lists shall be prepared in form to meet approval of the Architect and shall be framed under glass.

D. The Fire Protection Subcontractor shall provide for his work all valve charts including the Fire Protection Subcontractor's name and telephone number; date of chart; name and telephone number of Architectural Firm and Consulting Engineering Firm.

1.21 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

A. Refer to Section 017823 of Division 1 - General requirements for the requirements of this Section.

1.22 MANUFACTURER'S REPRESENTATIVE FOR START-UP OF SYSTEMS

A. The Fire Protection Subcontractor shall provide, at appropriate time or as directed by the Architect, the onsite services of a competent factory trained Engineer or authorized representative of particular manufacturer of equipment such as for the fire pump to instruct the Owner, inspect, adjust, test and place in proper operating condition any item provided by him, as applicable.

B. The Fire Protection Subcontractor, as applicable, shall commission and set in operating condition all major equipment and systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. In no case will major systems and equipment be commissioned by any of the Subcontractor's forces alone, without the assistance or presence of the equipment manufacturers.

C. A written report shall be issued by the particular equipment manufacturer and the Fire Protection Subcontractor summarizing the results of the start-up and performance of each system for the Architect's record. No additional compensation will be allowed for any Subcontractor for such services.

1.23 ELECTRICAL ROOM REQUIREMENTS

A. The Fire Protection Subcontractor shall not install any piping, or equipment in or through electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms, unless piping, or equipment is intended to serve these rooms. Additionally, no piping will be installed above electric panels or within the limits of any Code requirements. If the Fire Protection Subcontractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.

1.24 RECORD DRAWINGS

A. The Fire Protection Subcontractor shall maintain current at the site a set of his drawings on which he shall accurately show the actual installation of all work provided under his Contract indicating any variation from the Contract Drawings, in accordance with the General Conditions and Supplementary General Conditions. Changes whether resulting from formal change orders or

other instructions issued by the architect shall be recorded. Include changes in sizes, location and dimensions of piping, equipment, etc.

B. Utilizing the coordination drawings described herein before, the Fire Protection Subcontractor shall modify/correct/edit the fire protection work on the above CAD coordination drawings, to obtain a "CAD" set of Record Drawings. Provide (2) blackline prints (2) copies of record drawing CAD files.

C. A marked-up and colored-up set of prints on-site will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner's representatives and they shall be corrected if found either inaccurate or incomplete. This procedure is mandatory.

D. Coordination drawings are for the Contractor's, Architect's, and Owner's use during construction and shall not be construed as replacing any shop drawings. The cad coordination drawings, when corrected for actual "as-built" conditions, will be reviewed by the Architect, corrected and will be used to formulate the Record Drawings to be submitted to the Owner for his use.

E. The Fire Protection Subcontractor shall submit a set of CAD files on disc marked "AS-BUILTS". All costs associated with the production and reproduction of the CAD files shall be included under the fire protection bid for work under the fire protection contracts.

1.25 HOISTING EQUIPMENT AND MACHINERY

A. Refer to Division 1 - General Requirements for the requirements of this Section.

1.26 STAGING

A. Refer to Division 1 - General Requirements for the requirements of this Section.

1.27 SYSTEM DESIGN CRITERIA

A. Sprinkler systems and all components, piping, valves, head location, ratings, etc., shall be designed in accordance with NFPA 13, International Building Code and Owners Insurance Company and other applicable NFPA pamphlets governing the installation of alarm valves, system drains, etc. Fire Protection Subcontractor shall submit his shop drawings to City of Portland Fire Department and Owner's Insurance Company for approval prior to submission to Architect for approval.

B. The fire protection work is partially shown on the Fire Protection drawings. Each bidder for work under this Section of the specifications shall establish for himself, the exact quantity of heads required for the project and the exact extent of the work required. Refer to Architectural reflected

ceiling plans for preferred sprinkler head locations. Additional heads shall be provided as part of this Contract, as required, to satisfy the Code requirements for the hazard stated.

C. Each Bidder shall refer fire protection drawings for major fire protection system's components, piping, as to which areas are to have fire department valves, hose cabinets, etc.

D. Provide sprinkler system in all areas that are a part of this Contract.

E. Hydraulic calculations shall be based on flow characteristics specified herein and on actual flow test performed/data obtained by the Fire Protection Subcontractor. The Fire Protection Subcontractor shall perform his own up-to-date flow test to hydraulically calculate this project. The Fire Protection Subcontractor shall submit to the Architect for his review; indication of test location, date, flow, residual and static pressure, etc., as outlined in NFPA #13. The Fire Protection Subcontractor shall coordinate the flow test with the Owner and Portland Water District and pay all costs and fees associated with flow test at no additional cost to the Owners.

F. Sprinkler system design shall be based on the following information and in accordance with the Owner's Insurance Company requirements:

1. Sprinkler systems shall be provided throughout the building and shall be hydraulically calculated to provide densities as specified on the drawings with hose allowance as required.

2. Flow Test Data

a.	Test Date:	June 6, 2012
b.	Agency:	Portland Water District
c.	Static Pressure:	60 PSI
d.	Residual Pressure:	54 PSI
e.	Flow Rate:	1034 GPM
f.	Location:	Steven's Avenue, Portland, ME

3A. Sprinkler contractor shall be required to perform their own hydrant flow-test prior to design. Coordinate with Portland Water District. Pay all required fees.

4. The hydraulic calculations shall include the hydraulically most remote areas for systems supplied by more than one combination riser. Hydraulic calculations shall show the remote areas being supplied solely from the hydraulically most remote combination riser.

G. The Fire Protection Subcontractor shall state in his bid the exact number of heads he deems necessary to adequately sprinkler the entire project, including the unit cost to add or deduct a single head from this stated quantity. Head cost shall include the provision of 10'0" linear feet of pipe and required elbows and offsets customarily associated with the installation of each type of head to be installed.

H. The Fire Protection Subcontractor will be required to prepare detailed shop drawings as hereinbefore specified. This information in the form of a single "Package" shall be submitted to the Architect for review and approval prior to fabrication and installation. "Package" shall bear approval of Local Building Department, Local Fire Department and Underwriter's Agent of Owner's Insurance Company prior to submission to Architect for his review. Include flow test information noted above.

1.28 SUBMITTALS

A. Shop drawing submittals shall be prepared and submitted as described herein and in accordance with Section 013300 - Division 1 - General Requirements and as modified and noted hereinafter.

B. Prior to final shop drawing submittals, prepare HEAD LOCATION ONLY DRAWINGS depicting all sprinkler head locations and submit them to Architect for approval. These drawings shall show locations of all heads and all required dimensions, etc., and shall show sprinklers, lights, HVAC diffusers, ceiling tile patterns and access panel locations. This must be provided. Refer to Section 1.2A of this specification for other submissions.

C. Disposition of shop drawings shall not relieve the Fire Protection Subcontractor from the responsibility for deviations from drawings or specifications, unless he has submitted in writing a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Architect, nor shall such disposition of shop drawings relieve the Fire Protection Subcontractor from responsibility for errors in shop drawings or schedules.

D. Submittal Procedures and Format:

1. Review submittal packages for compliance with Contract Documents and then submit to Architect for review.

2. Verify quantities and type of medium to be submitted as outlined in Section 013300.

3. Each Shop Drawing shall indicate in title block, and each Product Data package shall indicate on cover sheet, the following information:

4. Title.

5. Name and location of project.

6. Names of Architect, Engineer, Contractor and Subcontractor(s).

7. Names of manufacturer, supplier, vendor, etc.

8. Date of submittal.

9. Whether original submittal or resubmitted.

10. Verify scale and type of drawings required.

11. Shop Drawings showing layouts of systems shall contain sufficient plans, elevations, sections, details and schematics to describe work clearly. They shall be minimum 1/8" = 1'0" scale unless specified otherwise. Provide larger scale details as necessary. Drawings shall show elements of Architect's reflected ceiling plan, exposed ductwork, walls, partitions, diffusers, registers, grilles, access panels, sleeves and other aspects of construction.

12. All firewalls and smoke partitions must be highlighted on the drawings for appropriate coordination.

13. Shop drawings showing manufacturer's product data shall contain detailed dimensional drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data, alone, is not acceptable), electrical requirements and wiring diagrams. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.

E. Shop drawings shall include but shall not be limited to the following:

1. Sprinkler work layout drawings, including location and sizes of piping, pumps, heads, guards, flushing connections, drains, test stations, alarm valves, bells, gongs, and all other accessories as required by NFPA #13.

2. Hydraulic calculations per NFPA #13, and Owner’s Insurance.

3. Equipment Cuts for:

   a. Alarm bell.
   b. Alarm valves.
   c. Inspector's test valves.
   d. Valves, gauges, drains and piping.
   e. Guards, spare head cabinet.
   f. Fire Department Connections with ball drip and check valves.
   g. Hangers, supports.
   h. Sprinkler heads, escutcheons.

i. Flow switches, tamper switches.
j. Access panels.

1.29 WORKING PLANS

A. Submit Working Plans and hydraulic calculations signed and sealed by Professional Engineer registered in state in which project is located to authorities that have jurisdiction, including:

1. Architect - as outlined in Division.
2. Insurance Underwriter
3. Fire Department
4. Authorities Having Jurisdiction

B. Submit Working Plans in one complete package. When it is not possible to submit entire system design in one package due to job conditions, submit plans of entire building indicating area not yet defined.

C. Working Plans shall be at least 1/8" = 1' scale on sheets of uniform size. Working Plans shall show all data required by NFPA Standards.

D. Working Plans will be subject to Architect's final approval. Submit to Architect after review by other authorities. If necessary to submit plans to Architect before review by other authorities, identify authorities that have not reviewed plans and resubmit for final approval when review by all parties is complete.

E. Pipe sizing shall be based on hydraulic calculations in accordance with NFPA requirements.

F. Working Plans are fabrication drawings provided to indicate actual sprinkler system and/or combination system piping layout.

1.30 SITE VISIT

A. Before commencing any work under this section, verify all governing dimensions, elevations and locations at the building and examine all adjoining work on which this work is in any way dependent for its perfect efficiency according to the intent of these specifications. Visit and investigate all spaces and conditions to become familiar with installation and all requirements prior to bidding.

B. Each bidder shall visit the site and inspect all conditions affecting any aspect of the work. Failure to do so and misinterpretation of the plans and specifications resulting therefrom shall be entirely the responsibility of the bidder.

1.31 CORE DRILLING

A. This subcontractor shall perform all core drilling required for the proper installation of the fire protection system. Locate all required openings and prior to coring coordinate the opening with the General Contractor. Thoroughly investigate the conditions in the vicinity of the required

opening prior to cutting. Care must be taken so as to not to disturb the hospital systems. Locate all other openings required for the General Contractor. All cored openings are to be by Fire Protection Contractor and all other openings are by the General Contractor. Patching of walls and openings shall be preformed by the respective trade responsible for the finish material in which the opening is made.

1.32 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Instruct to the Owner's satisfaction such persons as the Owner designated, in the proper operation and maintenance of all Fire Protection systems and equipment and their parts.

B. Furnish operating and maintenance manuals prior to instructions and forward same to the Architect for transmittal to the Owner.

C. This Contractor shall give detailed instructions for a period of not less than 5 days, straight time, to the responsible personnel designated by the Owner in the operation and maintenance of all systems and equipment furnished under this Contract. A letter with five copies containing the name of the person or persons to whom the instructions were given and the dates of instruction period shall be submitted to the Architect/Engineer. Start-up and testing of all equipment supplied by this Contractor shall be performed by authorized factory representatives supplying equipment. Notification of this work must be given to the Owner.

D. This Contractor shall submit to the Architect/Engineer for approval four sets of operating and instruction manuals, spare parts lists, drawings, manufacturer's bulletins and other pertinent data on all equipment furnished under this Contract. Each set shall be enclosed in a suitable hard cover binder. This information must be submitted to the Owner when systems are approximately 90% complete to allow for proper review prior to final instruction.

E. Provide name, address, and telephone numbers of manufacturer's representative and service company for each piece of equipment so that service parts can be readily obtained.

F. Upon completion of instructions this Subcontractor shall provide step by step typed procedures to test and operate each piece of equipment including detailed cross referenced drawings to procedure outlined so that all equipment may be tested, shut down, turned on or bypassed by the Owner's representative.

PART 2 - MATERIALS

2.1 PIPE AND FITTINGS

A. Piping shall meet applicable ANSI or ASTM standards requirements and shall have manufacturer's name and standard marked on each length. Joints shall meet applicable ANSI and ASTM standards requirements. Where ANSI and ASTM standard does not exist, joints and fittings shall bear UL listing symbol.

B Sprinkler distribution and branch piping 2-1/2" in size and larger may be Schedule 10 black steel. Piping for sprinklers 2" and smaller in size shall be Schedule 40 black steel. .

C. Piping for use with hole-cut fittings shall have machine cut holes per manufacturer requirements at predetermined positions, on the centerline of the pipe, of a size to receive the housing locating collar.

D. Piping for use with grooved end fittings shall be roll grooved without metal removal.

E. Branch outlet fittings shall be UL listed and FM approved, rated for300 psi (MWP) on piping 2-1/2" and larger equal to Victaulic. 300 psi fittings to be used on system where working pressure is less than 175 psi.

1. Mechanical tee branch, hole-cut type connections, with locating collar engaging into hole, with standard pressure responsive gaskets and black nuts and bolts; or

2. Outlet couplings, construction as hereinafter specified for couplings, with outlets grooved or threaded outlet ends with standard pressure responsive gaskets and black bolts and nuts.

3. No strap, snap and or one bolt outlet fittings will be permitted.

F. Standard black cast iron screwed fittings shall be used on piping 2" and smaller and may be used on larger sizes.

G. All grooved couplings, fittings and mechanical tee branch fittings shall be Victaulic or approved equal.

H. Bushings shall not be permitted where fittings of required sizes are manufactured. Care shall be taken in the design of this work to avoid piping arrangements that would require bushings.

I. Unless specified otherwise herein, all fittings shall be in accordance with NFPA standards and subject to approval by the Architect/Engineer. All fittings are to be UL listed.

J. All close and shoulder nipples shall be of corresponding materials as the pipe and shall be extra heavy pattern.

K. All piping for fire mains, fire department pumper connections, and sprinkler risers shall be Schedule 40 piping with approved Victaulic joints, 300 pound class minimum fittings.

L. Regardless of size or type, fire protection contractor is responsible to supply pipe and fittings approved for the high pressures that will be developed.

2.2 HANGERS AND SUPPORTS

A. Hangers shall be NFPA approved adjustable swivel ring 2" smaller and clevis hanger 2 ½" and larger supported from structural steel or concrete floors above by approved type clamps and supports. Spacing and hanger rod size shall be as outlined in NFPA Pamphlets or as specified herein.

B. Piping at all equipment and control valves shall be supported to prevent strains or distortions in the connected equipment and control valves. Piping at equipment shall be supported to allow for removal of equipment, valves and accessories with a minimum of dismantling and without requiring additional support after these items are removed.

C. All piping installed under this section of the specification shall be independently supported from the building structure steel and concrete decks and not from the piping, wood decks, ductwork or conduit of other trades. All supplementary steel including factory fabricated channels, required to meet the requirements specified herein shall be furnished and installed by the Fire Protection contractor.

D. All vertical drops and runout pipes shall be supported by split-ring extension type hangers.

E. Pipe supports, vertical and horizontal, shall not bear on sleeves.

2.3 SPRINKLER HEADS

A. All sprinkler heads shall be listed by Underwriters' Laboratories, Inc., and approved by Owner's Insurance Underwriter. All heads shall be manufactured by a single manufacturer. All sprinkler heads to be quick response unless noted.

B. Sprinkler heads shall be provided and installed to conform with manufacturer's listing.

C. All heads within 8' - 0" of the floor in mechanical areas shall have sprinkler guards.

D. Heads shall be installed in the center of tiles.

E. Refer to sprinkler schedule on drawings.

F. In addition to the sprinkler heads actually required, furnish spare heads of each type and temperature rating used, as required by NFPA 13. Heads shall be placed in a baked enamel steel

cabinet mounted as directed by the Owner. Cabinet shall contain two (2) socket wrenches and shall be of adequate size to hold required head quantity, but not less than six (6) of each type. Provide multiple cabinets if necessary.

2.4 FIRE DEPARTMENT CONNECTIONS (SURAFACE MOUNTED)

A. Fire Department connections shall be Underwriters' Laboratories listed with interior self-closing clapper in each opening. Units shall be manufactured of rough brass, polished chrome plated complete with caps, plugs and chains. Threads on outlets shall conform to local Fire Department specifications. Potter Roemer # 5751-D-Auto Sprinkler.

B. On branch line to pumper connection, provide approved straightway check valve installed in horizontal position. Piping shall be arranged to drain between check valve and siamese connection by approval ball drop connection piped to nearest drain or through wall..

C. Installation of the Fire Department connections shall be at location as shown on the drawings and/or approved by the Architect and all Authorities having jurisdiction.

2.5 VALVES

A. All valves shall be Victaulic MFG UL listed and FM approved, valves shall be rated at a minimum of 300 psi.

B. Shut-off and/or control valves shall be:

1. Outside screw and yoke valve. Cast iron body, bronze mounted, flanged ends, solid wedge, 300 psi, 2-1/2" in size and up. All bronze, 300 psi, solid wedge, threaded ends, 2" and under, all to be electrically supervised.

2. Bronze supervised slow close butterfly valve, threaded ends, stainless steel disc and stem, built-in supervisory switch, slow-close operator, up to 8" in size, 300 psi, or

3. Butterfly type indicating valves, ductile iron body, bronze disc, rubber seat, 300 psi, gear operator, with built-in supervisory switch, or
4. Pressure reducing valves shown on the drawings shall be UL listed and as manufactured by CLA-VAL Company model 90-21, or approved equal. Valve shall be rated for 300 psi with internal epoxy coating of the main valve.

C. Check valves shall be:

1. Iron body, bronze mounted swing check with flanged ends, 300 psi, 2-1/2" in size up to 8" size; or

2. Iron body, spring actuated, wafer check, 300 psi, sizes 4" through 8" UL; or

3. Grooved end, iron body, spring activated, 300 psi, sizes 2-1/2" through 6"; or

4. All check valves up to 2" in size shall be all bronze with screwed ends.

D. Trim Valves: (for use on inspectors test set ups, alarm check valves, dry pipe valves, etc.)

1. Gate valves - all bronze, 300 psi, solid wedge, outside screw and yoke, rising stem, screwed ends.

2. Ball valves - all bronze, 300 lb. WWP, screwed ends.

3. Globe valves - all bronze, 300 lb. WWP, screwed ends.

4. Check valves - all bronze swing check, rubber disc, 300 lb. WWP, screwed ends.

E. All valves that are installed as a part of this specification shall be provided with pressure ratings suitable for their intended service.

F. Test stations shall be Gem Mfg. or Victaulic Mfg. equal to Gem #F350 (TESTMASTER Assembly) sectional test and drain with 2" minimum pressure relief valve if required.

2.6 SPRINKLER ALARM BELL

A. Reliable System Sensor alarm bell, red color with appropriate labeling.

2.7 SIGNALING DEVICES

A. Valve monitor switches, sprinkler flow switches, water pressure alarm and low air pressure switches shall be furnished and installed by this Contractor, but wired by the Electrical Contractor.

1. Electrical supervisory switch locks or "tamper switches" shall be Viking, Gem, or Grinnell with two sets of double throw, single pole contacts. **No cords on switches allowed.**

2. Water flow alarm devices shall be Viking, Grinnell, or Gem, valve type, with two sets of double throw, single pole contacts and with 60 second time delay mechanism.

3. Reliable or approved equal 6" electric alarm bell for weatherproof operation.

B. The Fire Protection Subcontractor shall prepare a typewritten list of all equipment to which the Electrical Subcontractor shall make connections. This list shall include all electrical characteristics of each piece of equipment. This is to be done to insure items that the Fire Protection Subcontractor is to provide are compatible with the building electrical requirements. Submit this list prior to purchasing any equipment.

2.8 ACCESS DOORS

A. Furnish for installation by designated Trade as determined by the General Subcontractor access doors in all locations where valves, switches or other similar equipment are installed above plaster ceilings or behind walls or anywhere they become not accessible for inspection, maintenance or servicing. Access doors shall be a minimum of 18 inch by 12 inch or shall be sized to suit the access requirement to service the equipment and shall be located individually and in a manner approved by the Architect and to meet requirements specified here and elsewhere for specific applications.

B. Doors shall be set square and flush in cooperation with the Subcontractors. Particular attention shall be exercised in the selection of doors for masonry walls in order that frame sizes used, will match the courses of brick or block. Where possible, access panels shall be located in closets, storage rooms and/or other nonpublic areas and shall be constructed in a workmanlike manner. Doors shall be positioned so that the junction can be easily reached. Where access panels are required in corridors, lobbies or other habitable areas, they will be located as directed by the Architect.

C. Doors shall be constructed of steel with primer coat of rust inhibitive paint and shall have continuous piano hinge, as manufactured by Inland Steel Products Milcor, Miami, Walsh-Hannon or approved equal. Doors shall be key operated with flush operated cylinders, keyed alike. Key lock system shall be coordinated with the Hospital and shall be as approved by the Architect. Provide six (6) keys of type used for access panels for Owner's use. Obtain receipt of key delivery and submit to Architect for record.

1. Masonry non-rated walls Style "M" with 16 gauge frame and 14 gauge panel.

2. Masonry fire rated walls Fire Rated with FM and UL, 2 hour "B" rating, 16 gauge frame, 20 gauge sandwich type insulated panel.

3. Suspended lath and plaster ceilings Style "K" with 16 gauge frame, 14 gauge panel.

4. For access panels larger than 16 inches in either direction, provide two (2) locksets.

2.9 MAIN ALARM CHECK VALVE

A. Reliable Model E-6" alarm check valve with associated trim as shown on drawing. Valve to be rated for 300 psi working system pressure.

1. Wet alarm valve shall be UL listed and FMG approved for a wet pipe sprinkler system, complete with ductile iron body, flanged or grooved outlet, main drain valve, pressure gauges, alarm port, external bypass, hand hole with cover, hinged clapper assembly and other required trimmings. Valve shall be equal to Reliable Model E, Victaulic, Grinnel or Viking for variable pressure vertical installation with water motor and chrome plated gong. Water motor and gong shall be located on the outside of building. Supply pipe to gong and drain shall be IPS brass, galvanized steel or copper.

2. Excess pressure kit to be Gamewell #26615-7 with associated control wiring, pressure switches, supervisory panel, mounting brackets, pump and motor. Motor shall operate from differential pressure switch. Furnish with alarm lights and alarm dry contacts. Pump capacity: 1 GPM, 175 psi max, 1/4 HP, 120V.

3. Valve trim shall include pressure activated electric alarm switch.

2.10 SEISMIC BRACING

A. The Fire Protection Subcontractor shall provide all necessary design and materials for seismic restraint and protection of piping and devices against damage where subject to earthquakes as required for the entire plumbing system within the building. All isolation and seismic devices shall be the product of a single manufacturer. Products of other manufacturers are acceptable provided their systems strictly comply with this section of the specifications. Provide isolation materials and seismic restraints complete and as manufactured by Mason Industries, Tolco or approved equal.

B. The work under this section shall include the design, furnishing and installation of all restraint devices and systems as may be required for the fire protection system including, but not necessarily limited to, the following:

1. All fire protection equipment and devices.
2. All fire protection system piping as required.
3. Piping penetrations through floors and walls.
4. Sleeves with clearances around the outside, as recommended.
5. Equipment isolation bases.
6. Piping flexible connectors.
7. Seismic restraints for isolated equipment.
8. Seismic restraints for non-isolated equipment.
9. Certification of seismic restraint designs.

C. Submit ten (10) copies of descriptive data for all products and materials, including the following:

1. Catalog cuts and data sheets for the specific isolators, restraints and all other items to be utilized.
2. Details of methods of sleeving, fire protection smokeproofing and isolation for pipes penetrating walls and slabs.
3. Specific details of seismic restraints and anchors, including number, size and locations for each piece of equipment.
4. Calculations to support seismic restraint designs.
5. All calculations, details and other submittal materials shall be sealed and signed by a structural or civil engineer registered in the state and qualified to perform seismic design calculations.
6. A seismic design liability insurance certificate that must accompany all submittals.

D. Code and standards requirements shall include, but not be limited to:

1. Applicable IBC with any additional State or Local requirements.
2. NFPA 13 and 24 and other applicable NFPA standards.
3. All State and Local codes.

E. Manufacturers working in this section must provide a seismic design liability insurance certificate and certify their ability to provide engineering and design as required by this section. This certificate shall be submitted to the architect for review prior to any submittals.

1. Manufacturer’s Listed and Approved Design Manual

2.11 BUILDING AUTOMATION SYSTEM

The building automation system (BAS) shall be furnished and installed under another Section. The Fire Protection Contractor shall provide dual contact pressure switches, tamper switches, flow switches, tees, pipe wells, valve caps and/or additional contacts at equipment control/alarm panels to allow the connection from the BAS system to the piping and/or equipment where required. The following table itemizes the equipment, location and type of alarm or contact point and condition necessary to connect to the BAS system.

PIPE OR EQUIPMENT	TYPE OF ALARM, CONTACT POINT OR CONDITION WHICH SHALL BE MONITORED BY BAS	CONTROL	LOCATION
Main Alarm Check Valve	Open	Pressure Switch	Sprinkler Room – Basement Floor Level
Fire Protection Supply	Low Pressure	Pressure Switch	Sprinkler Room – Basement Floor Level

2.12 ELECTRICAL CONTROL AND INTERLOCKING WIRING

A. The electrical contractor shall furnish and install power wiring 480/208 volt, 120 volt connection only to all Fire Protection connected equipment including panels and motors. This Fire Protection subcontractor shall mount panels and shall furnish and install all control and interlocking wiring for each piece of Fire Protection equipment including but not limited to remote alarms and local alarms for all Fire Protection and equipment, alarms, pressure switches, flow switches and solenoid valves. All control wiring and interlocking wiring shall be installed in conduit and in accordance with the respective manufacturer's requirements and all connections shall be provided by the fire protection subcontractor. Wiring and conduit provided by this subcontractor shall be installed in accordance with the requirements of SECTION 16000 of the specifications.

B. All electrical panels and life support panels shall be equipped with connection for emergency power hook-up.

2.13 DOUBLE CHECK VALVE ASSEMBLY

A. Double check valve assembly on fire protection water service shall be Watts Model 709 double check assembly or FEBCO with FDA approved epoxy coated cast iron check valve bodies with bronze seats, bronze bodied ball valve test cocks, U.L., FM approved outside stem and yoke gate valve shut-offs, repair kit, test kit and pressure gauges. Valve assembly shall be mounted in accordance with City and State Requirements and properly secured to the wall or floor stand mounted. Assembly shall be tested and certified under AWWA std. No. C506 and FCCCHR of USC manual, Section 10 and listed by U.L.

2.14 DUCTILE IRON PIPE AND FITTINGS – FIRE SERVICES

A. Thickness Class 52 cement lined ductile iron pipe conforming to AWWA C151-7, flanged ends.

B. Fittings shall be ductile iron, cement lined, 250 psi rating, flanged ends.

C. Shall be used for Fire Protection water services outside of building. Shall be used for Fire

Protection service within building up to 6” DSCV assembly.

PART 3 - INSTALLATION

3.1 GENERAL

A. The contract drawings intend to show only the scope of the design, the fire protection subcontractor shall be responsible for the correct installation of this work in a manner satisfactory to the best practices of his trade to complete the scope of this subcontract in all respects. All roughing to equipment shall be accomplished in all details to Specifications of equipment manufacturer and to approval of Architect. No roughing work shall be accomplished until the pertinent manufacturer's shop drawings are approved.

B. The location of piping as indicated on the Drawings, unless otherwise noted, is diagrammatic only, and the exact locations shall be determined in the field. The run and arrangement of all pipes shall be approximately as shown on the Drawings, as directed during installation, in strict accordance with NFPA Pamphlets, and as straight and direct as possible, forming right angles or parallel lines with building walls and other pipes, and neatly spaced. All risers and standpipes shall be erected true and plumb, parallel with walls and other pipes, and neatly spaced. All horizontal runs of piping, except where concealed in partitions, shall be kept as high as possible and close to walls. All piping shall be concealed and concealed piping shall have a minimum number of fittings. Piping shall not interfere with the operation or accessibility of doors, windows, access panels, valves, H&V unit access, air flow patterns, or equipment, and shall not encroach on aisles or passageways. All piping shall be installed to preserve access to all valves, drains and equipment. Pipe will not be permitted to pass through footing, beams or ribs. Make such offsets and deviations from the Drawings as may become necessary to meet actual field conditions.

C. The Fire Protection Subcontractor shall be responsible for the correctness of field dimensions and shall check for himself all grades, lines, measurements, and other data in any way effecting his work. He shall refer to the project phasing schedule together with architectural and structural drawings of other trades for a full comprehension of the extent of the work to be performed and to avoid interference, and shall not be entitled to any extra compensation for any additional work or expense arising from his failure to do so. In case interference develops the Architect shall decide which work is to be relocated, regardless of which was first installed. Work installed by the fire protection subcontractor which is improperly located and/or interferes with or modifies either the phasing schedule or the architectural or structural design, shall be changed as directed by the Architect, and all costs incidental to such changes shall be paid by the fire protection subcontractor.

D. The fire protection subcontractor shall coordinate all his work with the work of all other trades, and shall so arrange his work that there will be no delay in the proper installation and completion of any part or parts of each respective work wherein it may be interrelated with his, so that generally all construction work can proceed in its natural sequence without unnecessary delay,

close coordination is also required with the HVAC, plumbing and electrical subcontractors in areas serving these trades.

E. Contact between piping and dissimilar metals such as hangers, building structural work, or equipment shall be avoided to prevent galvanic action.

F. Pipe shall be cut accurately to measurements established at the site and shall be worked into place without springing or forcing. All pipe, regardless of how cut throughout the job, shall be reamed smooth and all burrs removed before being installed. Pipe shall not be split, bent, flattened, nor otherwise injured either before or during the installation. Full lengths of pipes shall be used wherever possible and short lengths of pipe connected with couplings will not be permitted.

G. The Fire Protection Subcontractor shall use every precaution in the installation of all piping to prevent dirt, chips, or other foreign materials entering the inside of piping. All pipes shall be clean and blown out to the satisfaction of the Architect before closing of any line. Keep the ends of piping capped or blind flanged during the construction of the system to keep out dirt or other foreign matter. The plugs and caps are to remain until permanent and final installation is made. The use of paper, waste, rags and so forth to close openings will not be permitted.

H. Unions or flanges shall be installed at all equipment valves and at such other places as may be necessary to disconnect piping or at each piece of equipment or accessory which may have to be disconnected to make repairs.

I. Bushing will not be inserted in fittings for reduction in size where fittings of required size are manufactured.

J. The Fire Protection Subcontractor shall also provide the necessary data and supervision for the provision of all holes in the structure, and also for the installation of equipment foundations, including bolt hole templates, weights and manufacturer's recommendations for proper emplacement design. This shall be furnished to the General Contractor and other related subtrades.

K. Equipment and accessories shall be set level, plumb and in proper alignment with reference to adjacent walls. All surfaces coming in contact with walls, floors or other equipment shall have properly planed surfaces with suitable contact on wall and floors.

L. Sprinkler heads shall be located in centers of tile.

M. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible, before start of spray fiber work. Piping and equipment that interfere with proper application of fireproofing shall be installed after completion of spray fiber work. Patch and repair spray fireproofing cut or damaged during course of work specified under this Section. Trade responsible for damage shall bear cost of repair.

3.2 INSTALLATION REQUIREMENTS

A. Subcontractor shall comply with all the rules, Codes, Ordinances, regulations and requirements, of all legally constituted Authorities Having Jurisdiction over the whole or any part of the work herein specified. These requirements are minimum criteria and no reductions permitted by Code will be allowed without written permission of the Architect.

B. All equipment and materials furnished in connection with the installation shall be new and furnished in accordance with the requirements of this specification and they shall be of the best grade and quality of their respective kinds, free from natural, manufacturing or construction flaws, defects or irregularities and finish, fittings and workmanship shall be equal to the highest commercial grade.

C. Castings of all metals, of all kinds, shall be clean, smooth, close grained, of uniform thickness and free from all defects such as sandholes, blisters or cracks.

D. Before the installation will be accepted, Subcontractor shall have every portion of his work in a first-class working condition.

E. Where planning the installation of any of the apparatus herein called for, sufficient clearance shall be allowed to permit the removal and replacing of parts that may require future removal for repairs and replacement.

3.3 TEMPORARY STANDPIPE SYSTEMS

A. All standpipe risers shall continue up through the floors and temporary hose, nozzles and valves provided as required as the floors are erected for fire protection during construction. Standpipes shall be supplied through a temporary siamese inlet at grade located where directed by the Fire Department. Access to temporary siamese inlet connection shall be kept clear and accessible at all times. It shall be the responsibility of this Subcontractor to insure this temporary fire protection supply be available at all times. All valves shall be properly adjusted for the maximum pressure setting allowable as required and a typewritten report of such tests and adjustments shall be submitted to the Architect/Engineer.

3.4 IDENTIFICATION

A. All labeling of piping, materials and equipment, as outlined hereinafter for identification purposes, shall be performed by this Contractor.

B. Piping systems shall be identified with approved snap-on covers designating services and direction of flow. Location of identification covers shall be near access panels wherever possible

and on both sides of valves. The markers shall be as manufactured by WH Brady Co., Westline Products, Seton Name Plate Co., or approved equal.

C. Before the snap-on labels are applied, piping shall be thoroughly cleaned and painted, if specified.

D. Letters shall not be less than 1-1/2" in height. Arrows shall not be less than 9" long. Identification shall be installed on pipes above hung ceiling and furred spaces.

E. All systems shall be identified at intervals of approximately 20' change of direction and on both sides of wall where pipes pass through walls.

3.5 TESTING AND INSPECTION

A. This Contractor shall obtain and pay for all the inspection and tests required for this Section of the work. Defects discovered in work, materials and/or equipment shall be replaced at no cost to the Owner, and the inspection and test shall be repeated. When work is completed, this Contractor shall furnish a Certificate of Inspection and Approval to the Owner before final payment of the Contract will be allowed.

B. Test sprinkler piping and make watertight before concealment. Make partial tests as required, during the progress of the work. All tests shall be witnessed by the Owner's representative, Authorities Having Jurisdiction and a representative of the Engineer.

C. Sprinkler system shall be tested to a hydrostatic test of 400 psi for two (2) hours in accordance with NFPA as a minimum testing requirement.

D. This Subcontractor shall, with the parties noted herein, establish procedures to witness testing that are acceptable to the parties noted herein. All parties noted herein shall be notified in writing of the accepted testing procedure prior to any testing. This Subcontractor shall notify parties designated to witness testing at least 48 hours in advance of scheduled testing.

E. Conditions requiring testing in excess of the minimum requirements noted herein shall be performed in accordance with NFPA standards and any requirements of Authorities Having Jurisdiction.

F. Should the Owner, Architect, Engineer or any Authority Having Jurisdiction require, this Subcontractor shall provide factory trained, manufacturer's authorized representatives to perform testing on any equipment and/or devices that may be an integral part of this specification.

G. Dispose of test water and wastes after tests are complete, in a manner satisfactory to the Architect.

H. Furnish to the Architect/Engineer completely executed test certificates with signatures of those required to witness testing. Test certificate forms shall follow NFPA formats as a minimum requirement.

I. All electrical alarm devices are to be tested and adjusted in conjunction with the Electrical and/or Fire Alarm Subcontractors. Testing or retesting and adjustment of these devices shall be at no additional cost to the Owner. Testing and adjustment shall be as required until these devices are performing as an integral part of the total alarm system as specified for that part of the work.

3.6 CLEANING OF SYSTEMS

A. Before the Fire Protection Systems are accepted, all equipment shall be thoroughly cleaned to remove all dust, dirt, and/or other foreign matter which may be detrimental to the operation of the Systems or building finishes.

B. After the installation is complete, equipment with factory finished surfaces shall be cleaned. Damaged or scratched spots shall be touched up with the same type and color paint as applied at the Factory.

C. All equipment that is to receive finish paint by the Painting Contractor shall be cleaned by this Contractor and left ready to have surfaces prepared to receive paint.

3.7 EQUIPMENT ACCESS REQUIREMENTS

A. All work shall be installed so that all parts requiring inspection, operation, maintenance and repair are readily accessible. Minor deviations from the Drawing may be made to accomplish this, but changes of magnitude shall not be made prior to written approval from the Architect.

B. Furnish access panels if required in walls and ceilings as required to permit access for adjustment, removal and the replacement and servicing of all equipment, and all other items requiring maintenance and adjustments. Access panels shall be installed by the General Contractor or respective Subcontractor.

3.8 SIGNS

A. Signs and nameplates in accordance with NFPA standards and/or this specification shall be provided at all drains, test and alarm valves and other areas as required by NFPA Standards.

3.9 MATERIALS AND EQUIPMENT HANDLING

A. Refer to Section 01600 of Division 1 - General Requirements for the requirements of this Section.

3.10 CLEANUP

A. After completion of the work, all tools and other equipment shall be removed from the building. All excess materials shall be removed and the building left broom clean. All cabinets, valves, and equipment shall be cleaned and polished.

B. This Contractor shall clean, patch and repair any material and finish of the building or its contents damaged during the execution of this Contract.

3.11 PROJECT CLOSE-OUT

A. In order to closeout the project the contractor must submit to the Owner (3) binders that include copies of the following:

1. Inspectional services sprinkler permit to install Fire Protective Systems.

2. Portland Fire Department permit to install a fire extinguishing system: 14:02.

3. Contractor's material and test certificate for above ground piping for Automatic Sprinkler Systems (NFPA 13).

4. Tamper and Flow Alarms; Certificate of Completion NFPA 72. To be provided by electrical Subcontractor or alarm service company.

5. A copy of an affidavit from the Architect or Engineer, of record, whose competency is consistent with the registration laws and regulations of The State of Maine. The affidavit shall indicate that he or she has made on-site visits and that the work has been completed satisfactorily as required.

END OF SECTION

SECTION 220000 – PLUMBING

INDEX

SECTION 220000 - PLUMBING

PART 1 – GENERAL

1.1 REFERENCES

A. All of the Contract Documents, including General and any Supplementary Conditions and Division 1- General Requirements, apply to the work of this Section.

B. Examine all Drawings and all other Sections of the specifications for requirements herein affecting the work of this trade.

C. This specification requires a preparation and submissions of drawings and other documents, procurement of approvals and provision of a complete functional plumbing systems. As a result, this Section serves dual purposes of providing specifications and indicating design criteria for the Plumbing Subcontractors use and guidance in preparing plumbing installation drawings and other documents for approvals.

D. The bid for work under Section 224800 shall be included with this bid.

1.2 DEFINITIONS

A. Words in the singular shall also mean and include the plural, wherever the context so indicates and words in the plural shall mean the singular, wherever the context so indicates.

B. Wherever the terms “shown on drawings” are used in the specifications. they shall mean “noted”. “indicated”, “scheduled”, “detailed”, or any other diagrammatic or written reference made on the drawings.

C. Wherever the term “provide” is used in the specifications it will mean “furnish” and “install”, “connect”, “apply”, “erect”, “construct”, or similar terms, unless otherwise indicated in the specifications.

D. Wherever the term “material” is used in the specifications it will mean any “product”, “equipment”, “device”, “assembly”, or “item” required under the Contract, as indicated by trade or brand name, manufacturer’s name, standard specification reference or other description.

E. The terms approved”, or “approval” shall mean the written approval of the Architect.

F. The term “specification” shall mean all information contained in the bound or unbound volume, including all “Contract Documents” defined therein, including all drawings.

G. The terms “directed”, “required”, “permitted”, “ordered”, “designated”, “prescribed” and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect. The terms “approved”, “acceptable”, “satisfactory” and similar words shall mean approved by, acceptable or satisfactory to the Architect. The terms “necessary”, “responsible”, “proper”, “correct” and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.

H. “Piping” includes in addition to pipe or mains, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

I. “Concealed” means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.

J. “Exposed” means not installed underground or “concealed” as defined above.

K. “Plumbing Sub-Contractor”, refers to the Sub-Contractor or his Sub-Contractors responsible for furnishing and installation of all work indicated in the Plumbing specifications and as shown on the plumbing drawings.

1.3 SCOPE OF WORK

A. Work Included: The scope of work, without limiting the generality thereof, consists of furnishing all labor, materials, plant, transportation, equipment, accessories, appurtenances, and services necessary and/or incidental to the proper completion of all plumbing work shown on the drawings, described in the specifications, or as reasonably inferred from either, in the opinion of the Architect, as being required, and includes, but is not limited to:

All work in Section 224800 Medical Gas, Dental Air and Dental Vacuum system
Domestic water service to 10’-0 from building
Soil, waste and vent systems to 10'-0" from building
Roof drain and conductor pipe system to 10'-0" from building
Domestic cold and hot water systems
Non-domestic cold and hot water systems
Natural gas piping system
Insulation
Plumbing fixtures
Floor, second roof drains
Instructions to Owner
Backflow preventers
Water meter
Core drilling
Furnishing of access panels
Building automation system connections
Testing, disinfection and certification
Connections to plumbing connected equipment and sterilizer equipment furnished under other sections (washers, sterilizers, casework equipment, etc.)

Valves and accessories
Cleanouts
Domestic water heaters and circulators
Chair carriers and supports
Installation of toilet accessories
Trap primers
Shock absorbers/air chambers
Wall hydrants
Record coordination drawings - CADD Submission
Thermostatic master mixing valves
Pure water piping system
Point of use mixing valves
Hangers, sleeves and appurtenances
Pressure reducing valves
Core drilling
Indirect wastes
Interlocking and control wiring
Cleaning and adjusting
Staging, scaffolding and rigging
Seismic restraints
Installation of fireproofing sleeves
Miscellaneous iron and steel
Water filtration system (turnkey)
Sewage Ejector
Sewage Ejector pumps

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. Electrical Work - Section 260000.

B. Finish Painting - Section 099123.

C. Temporary power for operation of pipe cutting, welding and threading tools - Section 015000.

D. Fire Protection Work - Section 211100.

E. Heating Work - Section 230000.

F. Concrete housekeeping pads - Section 033000.

G. Installation of access panels - Trades in which they occur section 083113.

H. Excavation, backfill and resurfacing - Earth Work - Division 2.
I. Drainage structures and appurtenances - Section 0330515 beyond 10 feet.

J. Toilet accessories - Section 102800.

K. Site utilities beyond 10 feet from building Division 2.

1.5 CODES, STANDARDS AND REFERENCES

A. All materials and workmanship shall comply with all applicable State Codes, Specifications, Local and State Ordinances, Industry Standards, Utility Company Regulations and latest editions.

B. In case of difference between State Building Codes, State Laws, Local Ordinances, Industry Standards, Utility Company Regulations and the Contract Documents, the Plumbing Subcontractor shall promptly notify the Architect in writing of any such difference.

C. In case of conflict between the Contract Documents and the requirements of any Code, Authorities having jurisdiction, the most stringent requirements of the aforementioned shall be included in the bid and assume that will be provided unless otherwise directed by the Architect after award of Contract.

D. Should the Plumbing Subcontractor perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations, he shall bear all costs arising in correcting the deficiencies, as approved by the Architect.

E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations, and the applicable requirements of the following accepted Codes and Standards, without limiting the number, as follows.

1. Local and state building, plumbing, mechanical, electrical, fire and health department codes.
2. National Fire Protection Association (NFPA)
3. Occupational Safety and Health Act (OSHA)
4. Building Owner’s Insurance Company
5. Underwriters' Laboratories (UL)
6. International Building Code 2009

F. In these specifications, references made to the following Industry Standards and Code Bodies are intended to indicate the accepted volume or publication of the Standard. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:

1. ANSI American National Standards Institute
2. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
3. ASME American Society of Mechanical Engineers
4. ASTM American Society of Testing Materials
5. AWS American Welding Society

6.	CS	Commercial Standards, U.S. Department of Commerce
7.	FM	Factory Mutual
8.	NFPA	National Fire Protection Association
9.	CGA	Compressed Gas Association
10.	FS	Federal Specification, U.S. Government
11.	HI	Hydraulics Institute
12.	MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
13.	NEMA	National Electrical Manufacturers Association
14.	OSHA	Occupational Safety and Health Act
15.	UL	Underwriters' Laboratories, Inc.

G. The Plumbing Subcontractor for the work shall give all necessary notices, obtain all permits, pay all governmental taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. The Plumbing Subcontractor shall obtain and pay for all required Certificates of Inspection for his work and deliver same to the Architect before request for acceptance of his portion of work is made and before final payment.

1.6 GUARANTEE

A. Attention is directed to provisions of the General Conditions and Supplementary General Conditions regarding guarantees and warranties for work under this Contract.

B. Manufacturers shall provide guarantees for work under this Contract. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and the Contractor may have by Law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the systems, as determined by the Architect and shall remain in effect for a period of (12) months thereafter.

C. All materials, items of equipment and workmanship furnished under each Section shall carry the standard warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the Plumbing Subcontractor including all other damage done to areas, materials and other systems resulting from this failure.

D. The Plumbing Subcontractor shall guarantee that all elements of the systems provided under his Contract, are of capacity to meet the specified performance requirements as set forth herein or as indicated on the drawings.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the Plumbing Subcontractor, within (5) working days, at no cost to the Owner.

F. The Plumbing Subcontractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

G. Upon final acceptance of the project by the Owner, the (1) year guarantee period of all equipment and materials will be initiated. During this period, the Contractor shall make a minimum of (2) visits to the site (6) months after acceptance and immediately prior to the end of the guarantee period). These visits shall be performed in the presence of the Owner's representative. During each visit, the Contractor shall thoroughly check all equipment for proper operation and respond to any list of deficiencies prepared by the Owner. Formal reports shall be generated and forwarded to the Department of Engineering and Architect's Office describing the systems inspected, date of inspection and status of equipment.

1.7 THE SUBCONTRACTOR

A. The Plumbing Subcontractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications and shall take all responsibility for and bear all losses resulting to him in the execution of his work.

B. The Plumbing Subcontractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed directly or indirectly by the Plumbing Subcontractor shall perform their work according to all the conditions as set forth in these specifications.

C. The Plumbing Subcontractor shall furnish all materials and do all work in accordance with these specifications and any supplementary documents provided by the Architect. The work shall include every item shown on the drawings and/or required by the specifications as interpreted by the Architect. All work and materials furnished and installed shall be new and of the best quality and workmanship. The Plumbing Subcontractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed

1.8 COORDINATION OF WORK

A. The Plumbing Subcontractor shall compare his drawings and specifications with those of other Trades as well as the Architectural drawings and specifications, and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the plumbing work. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, Plumbing Subcontractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the plumbing work caused by the Plumbing Subcontractor's neglect, shall be made by him at his own expense, to the Architect's satisfaction. The Plumbing Subcontractor must include in his bid sufficient dollar amounts to coordinate the work of this Contract.

B. Locations of pipes and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. The Plumbing Subcontractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component.

C. Lines which pitch shall have the right-of-way over those which do not pitch, For example: waste piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.

D. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The Plumbing Subcontractor shall provide cleanouts and drains as required for his work to effect these offsets, transitions and changes in direction.

E. All work shall be installed in a way to permit removal (without damage to other parts) of coils, filters, control appurtenances, shafts, sheaves and drives and all other system components provided under this Contract requiring periodic replacement or maintenance. All piping shall be arranged in a manner to clear the openings of swinging overhead access doors as well as ceiling tiles. All work shall be done to allow easy access for maintaining equipment. The Owner and Engineer will require proof via the preparation of large scale sections and part plans that valves, cleanouts, etc. are accessible after the work is completed. Any items in the field discovered to be in non-compliance shall be removed and relocated, as required, and as directed by the Architect.

F. The Contract Drawings are diagrammatic only intending to show general runs and locations of piping, equipment, terminals and specialties and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom.

G. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, flow switches, etc., exist, such conflicts shall be reported to the Architect during bidding and prior to signing of the Contract. If such action is not taken, the Plumbing Subcontractor shall furnish such items as part of his work as necessary, for complete and operable systems and equipment, as determined by the Architect.

H. The Plumbing Subcontractor shall coordinate the installation of all equipment and any catwalks or service platforms provided.

I. Where drawing details, plans, specification requirements and/or scheduled equipment capacities are in conflict and where pipe sizes of same pipe are shown to be different between plans and/or between plans and sections or details, the most stringent requirement will be included in the Contract. Plumbing systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to

be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.

J. Final location of all exposed control valves, access panels, fixtures, control devices, wall hydrants, hose bibbs etc., shall be coordinated with the Architectural reflected ceiling plans and/or other Architectural details, as applicable. Obtain approval of locations of all devices from Architect in the field. Equipment shown on the plumbing and/or Architectural drawings to be provided with services, shall be included under this Contract as applicable, including all piping connections to systems, to make equipment complete and operable. Additional piping, flexible fittings, etc., shall be provided to accomplish the above requirement, as required, all as part of this Contract, at no extra cost to the Owner. This requirement necessitates that the Plumbing Subcontractor review the architectural drawings and the drawings of other Trades during bidding to ascertain the extent of all requirements, and interface between the Trades and scope of work.

K. The Plumbing Subcontractor shall coordinate his work with other Trades' work so that all equipment and systems can be easily, safely and properly serviced and maintained. It is imperative that service personnel can safely access all equipment. Provide safety rails, steps, ladders, valve chains, handle extensions, etc. as required, in addition to the ones shown on the drawings, to ensure safe and easy access to all equipment and is provided in a manner approved by the Architect and the Owner's Project Manager

1.9 GIVING INFORMATION

A. The Plumbing Subcontractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the Architect and other Contractors sufficiently in advance of the work so that all openings may be built in advance.

1.10 EQUIPMENT AND MATERIALS

A. Equipment and materials shall be delivered to the site and stored in location as directed by the Architect, in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls, filters, etc., shall be stored in dry, heated spaces.

B. The Plumbing Subcontractor shall have his equipment tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned, polished thoroughly and turned over the Owner in a condition satisfactory to the Owner and Architect. Damage or defects developing before acceptance of the work shall be made good at the Plumbing Subcontractor's expense.

C. The Plumbing Subcontractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.

D. The manufacturers listed within this specification establish the standards of quality required, either by description or by references to brand name, name of manufacturers or manufacturer's model number. Where one product only is specifically identified by name or manufacturer's model number, the Plumbing Subcontractor shall base his bid on the use of the name product. Where multiple names are used, the Plumbing Subcontractor shall base his bid on the use of any of those products named. The Plumbing Subcontractor shall submit with his bid, the names of products which are proposed as substitutions for products named in the specifications. Each proposed substitution shall be accompanied by a written statement of money to be added or deducted from his bid. The Owner reserves the sole right to accept or reject said substitutions with or without cause. When equipment and/or materials are proposed to be purchased from a manufacturer other than those specified, the Plumbing Subcontractor shall provide with his bid, data sufficient to inform the Owner and Engineer of the basis of equality of the substitution to that of the equipment and/or materials specified. When equipment other than that specified is used, the Plumbing Subcontractor shall be solely responsible for any extra cost of required revisions such as structural steel, concrete, electrical, piping, and any engineering review, coordination with other Trades, or redesign, etc. Such additional cost shall be identified at the time such substitutions are proposed and incurred by the Plumbing Subcontractor.

E. Manufacturers' directions shall be followed completely in the delivery, storage, protection and installation of any equipment. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's written instructions before proceeding with the work. Should the Plumbing Subcontractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.

F. The Plumbing Subcontractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.

G. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of the Plumbing Subcontractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, the Plumbing Subcontractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Plumbing Subcontractor shall make all necessary changes in all affected related work provided under other Sections including location of roughing-in connections by other Trades, electrical requirements, piping, supports, insulation, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.

H. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. Equipment and materials shall be products which will meet with the acceptance of the Authorities having jurisdiction over the work and as specified hereinbefore.

Where such acceptance is contingent upon having the products listed or labeled by FM, UL or other testing laboratories, the products shall be so listed or labeled. Where no specific indication as to the type or quality of material or equipment is indicated, a first class standard article shall be provided.

I. All equipment of one type (such as valves, piping, heaters, water system components, drainage specialties, etc.), shall be the product of one manufacturer.

J. Equipment furnished by the Owner, if assigned to the Plumbing Subcontractors, shall be received, inspected, installed, etc., as if they were purchased by the Plumbing Subcontractor. All guarantees, service contracts, etc., shall be the same as for all other equipment provided under this Contract. Make all connections, and provide all piping and controls as necessary.

1.11 CUTTING AND PATCHING

A. The Plumbing Subcontractor shall be responsible for all core drilling, as required for work under his Contract, but in no case shall he cut into any structural elements without the written approval of the Architect.

B. All cutting, rough patching and finish patching shall be provided under this Contract.

C. All concrete and masonry equipment bases and pads shall be provided by the Other Work Contractor.

1.12 USE OF PREMISES

A. The Plumbing Subcontractor shall confine all of his apparatus, storage of materials and construction to the limits indicated on the drawings and directed by the Architect and he shall not encumber the premises with his materials.

B. In storing materials within areas (structure or ground), or when used as a shop, the Plumbing Subcontractor shall consult with the other work Contractor and shall restrict his storage to space designated for such purposes. The Plumbing Subcontractor will be held responsible for repairs, patching or cleaning arising from any unauthorized use of premises.

C. Notwithstanding any approvals or instructions which must be obtained by the Plumbing Subcontractor from the Architect in connection with use of premises, the responsibility for the safe working conditions at the site shall remain the Plumbing Subcontractor's and the Architect or Owner shall not be deemed to have any responsibility or liability in connection therewith.

1.13 PROTECTION

A. All materials such as valves, fittings, piping, etc., shall be properly protected and all piping openings shall be temporarily closed by the Plumbing Subcontractor installing same, so to prevent obstruction and damage. The Plumbing Subcontractor shall take precautions to protect his materials from damage and theft.

B. The Plumbing Subcontractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or electrical systems provided under his Contract.

1.14 DAMAGE TO OTHER WORK

A. The Plumbing Subcontractor shall be held responsible and shall pay for all damages caused by his work to the new building structures and equipment, piping, etc., and all work and finishes installed under this Contract in the new or in existing building. Repair of such damage shall be done as hereinbefore specified, at the expense of the Plumbing Subcontractor and to the Architect's satisfaction.

1.15 CORRECTION OF WORK

A. The Plumbing Subcontractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after completion of work and whether or not fabricated, installed or completed. The Plumbing Subcontractor shall bear all costs of correcting such rejected work.

B. The above requirements will also apply to work observed to be in conflict with 220000-1.8 "Coordination of Work" as it relates to installations not allowing accessibility to all system components.

1.16 EXTRA WORK

A. No claim for extra work will be allowed unless it is authorized by the Architect in writing before commencement of the extra said work.

1.17 TOUCH-UP PAINTING

A. The Plumbing Subcontractor shall thoroughly clean all equipment and systems provided under this Contract from rust, splatters and other foreign matter or discoloration, leaving every part of each system in an acceptable prime condition. The Plumbing Subcontractor, for the work under his Contract, shall refinish and restore to the original condition all equipment and piping which has sustained damage to the manufacturer's prime and finish coats of paint and/or enamel.

1.18 PIPE SLEEVES, PLATES AND ESCUTCHEONS, FIRESTOPPING AND SMOKEPROOFING

A. **Where pipes pass through all walls and floors**, the Plumbing Subcontractor shall provide and set individual sleeves for each pipe and all other work under his charge, as necessary for passage of all pipes. Sleeves shall be of sufficient size to provide 1/2" air space around the pipe passing through (including insulation where pipes are insulated). Where pipes are to be insulated, insulation shall run continuous through sleeves. All openings shall be sealed, smokeproofed and made tight. The Plumbing Subcontractor shall be responsible for the exact location of sleeves provided under this Contract and shall coordinate all requirements for piping sleeves.

B. The Plumbing Subcontractor, for work under his charge, shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation, and he shall prepare sleeving and opening drawings for the use of these drawings by the other work contractor.

C. Sleeves and inserts shall not be used in any portions of the building, where their use would impair the strength or construction features of the building. Elimination of sleeves must be approved by the Architect.

D. Provide chrome-plated brass escutcheons with set screw for exposed piping, in all areas except in mechanical rooms. In these areas use plain brass or cast iron escutcheons suitable for painting. All escutcheons shall be sized to fit the bare pipe or insulation in a snug and neat manner. They shall be of sufficient size to cover sleeved openings for the pipes and of sufficient depth to cover sleeves projecting above floors. Escutcheons shall be as manufactured by Beaton & Caldwell, Dearborn Brass or Grinnell.

E. Pipe sleeves shall be required on **all** pipes passing through all walls and shall be made of Schedule 40 pipe, 16 gauge galvanized steel or 16 gauge steel as follows:

1. Sleeves on pipes passing through masonry or concrete construction shall be Schedule 40 pipe.
2. Sleeves on pipes passing through drywall construction shall be 20 gauge galvanized steel.
3. Sleeves on pipes passing through fire rated drywall partitions shall be 16 gauge steel.
4. Exterior wall sleeve through masonry walls shall be made watertight by the use of Mechanical Link Seal Joint as MFG by Century Products MFG.

F. Pipe sleeves shall be set as follows:

1. Set sleeves 1" above finish floor (3" at mechanical rooms) and flush on each side of walls, except sleeves through floor occurring in walls and partitions shall terminate 1" above the finished floor.
2. Sleeves shall be set securely in place before concrete is poured.

G. The Plumbing Subcontractor shall firestop or smokestop the space between the sleeves provided under his Contract and pipes as applicable, as follows:

1. Materials shall bear label issued by qualified laboratory and specifically indicating that the product has been tested to ASTM E814 Standard, shall be as manufactured by Bio Fireshield Inc. or Dow Corning Corp., and shall include the following:

   a. Dow Corning silicone RTV foam (penetration fill material) complete.
   b. Dow Corning 96-081 RTV silicone adhesive sealant.
   c. Mineral fiber board, mineral fiber matting, and mineral fiber putty may be utilized for forming and damming materials used to contain the liquid silicone RTV foam mixture prior to and during foam-filling penetrations. Damming and forming materials shall be fire tested and functionally approved and shall be capable of being left in place to become an integral part of the foamed penetration wall.

2. Materials shall be delivered in their original, tightly sealed containers or unopened packages, all clearly labeled with the manufacturer's name, product identification and lot numbers where appropriate.

3. Installation shall comply with the following:

   a. Penetration seal preparation shall include use of the procedures, techniques and quality control standards recommended by the product manufacturer, as follows:
   b. Remove all incidental combustible materials and loose impediment from the penetration opening and involved surfaces.
   c. Remove free liquids or oil from all involved surfaces and penetration components.
   d. Install the specified damming materials to accommodate and insure the proper thickness/fire rating requirements and provide containment during foaming.
   e. Foam mixing and dispensing of equipment and materials shall be in strict accordance with manufacturer's instructions.

4. The materials installation procedures, clean-up, safety precautions and requirements shall be in accordance with Dow Corning published information relative to "Safe Handling Procedures", use of safety shoes, goggles, etc.

5. All firestopping materials must be applied in direct accordance with their UL label certification.

6. The Plumbing Subcontractor shall submit a mockup of every type of firestopping method used on this project for approval by the Architect at the site. The firestopping methods must be approved prior to installation of systems.

H. Except as otherwise specified, underground piping passing through exterior walls, foundation slabs on grade, or manhole walls, shall have penetration closures of the modular mechanical type,

consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous belt around the pipe and with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between the pipe and wall, reducing chances of cathodic reaction between these members. The Plumbing Subcontractor for work under his charge shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation. The inside diameter of the wall opening shall be sized to fit the pipe and ensure a watertight joint. Where applicable, when installing seals, take into account the pipe O.D. if non-standard due to coating or jacketing.

1.19 WATERPROOFING, FLASHING AND COUNTERFLASHING

A. Unless specifically indicated otherwise on the drawings, the Plumbing Subcontractor shall provide all counterflashing and waterproofing of all piping and equipment provided by him, which pierce roofs, walls and other weather barrier surfaces. All work under this Section shall be coordinated with the Other Work Contractor.

B. All work shall be performed in a workmanlike manner to ensure weatherproof installation. Any leaks developed due to this Contractor's work shall be repaired at his expense, to the Architect's satisfaction.

C. Pipes passing through slabs shall have the sleeve extended above floors as hereinbefore specified to retain any water and the space between the pipe and sleeve caulked with lead wool. The top shall be sealed with lead and the bottom shall be sealed with monolastic caulking compound.

D. Subcontractor shall provide and install counterflashing to overlap the base flashing by 4". Flashing shall be fastened with matching clamp rings or by brazing, welding or soldering.

1.20 MISCELLANEOUS IRON AND STEEL

A. The Plumbing Subcontractor shall provide all steel supports and hangers as shown on the drawings or required to support all equipment, systems or materials provided under this Contract.

B. All work shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets and framework shall be properly sized and strongly constructed.

C. Measurements shall be taken on the job and worked out to suit adjoining and connecting work. All work shall be done by experienced metal-working mechanics. Members shall be straight, true and accurately fitted.

D. Welded joints shall be ground smooth where exposed. Drilling, cutting and fitting shall be done as required to properly install the work and accommodate the work of other Trades as directed by them.

E. Members shall be generally welded except that bolting may be used for field assembly where welding would be impractical. Welders shall be skilled and certified. Bolts, nuts and washers shall be high tensile type, minimum 3/4" diameter, conforming to ASTM.

F. All shop and field fabricated iron and steel work shall be cleaned and dried and given (1) coat of rust inhibiting paint on all surfaces and in all openings and crevices.

1.21 ELECTRICAL WORK, MOTORS, MOTOR CONTROLLERS

A. The Electrical Subcontractor shall provide power wiring to all equipment provided under Section 220000. All control wiring shall be installed in conduits and in accordance with the respective equipment manufacturer requirements. All connections shall be provided by the Plumbing Subcontractor. All conduit and wiring provided by the Plumbing Subcontractor shall be installed in accordance with the requirements of Section 26000 of these Specifications.

B. Motors shall be built in accordance with latest Standards of NEMA and as specified. Motors shall be specifically and expressly wound for voltage required.

C. Motors shall be tested in accordance with ANSI 50 and conform thereto for insulation resistance and dielectric strength.

D. Motors shall be provided with adequate starting and protective equipment as specified or required and with conduit terminal box of size adequate to accommodate conduits and wires.

E. Capacity shall be sufficient to operate motors under job conditions of operation and load, without overload and shall be at least the horsepower size indicated or specified.

F. All motors shall be suitable for continuous duty at rated horsepower, with temperature rise not to exceed 40°C for dripproof motors, 50°C for splashproof motors, 55°C for totally enclosed motors. All motors shall be capable of 15% overload without overheating.

G. Direct connected motors shall be furnished with adjustable base. Motors connected to driven equipment by belt or shaft shall be furnished with adjustable sliding bases, except for fractional motors which shall be furnished with slotted mounting holes.

H. Motors smaller than 1/2 HP shall be capacitor, starter or split-phase type. Motors 1/2 HP and larger shall be squirrel cage, induction type. Motors 1 HP and larger shall have grease lubricated ball bearings and approved grease fittings.

I. All electrical apparatus and controls furnished as a part of the plumbing work shall conform to applicable requirements under Electrical Section.

J. The Plumbing Subcontractor shall provide the Electrical Subcontractor with all motor size and wiring requirements within (15) days from date of Contract to allow proper coordination of Trades by the other work Contractor.

K. The Plumbing Subcontractor shall verify with the Electrical Subcontractor available electrical characteristics before ordering any equipment or motors.

L. Equipment which includes a number of correlated electrical control devices mounted in a single enclosure or on a common base with equipment, shall be supplied for installation completely wired internally with terminal strip ready for external wiring. Unless specifically directed otherwise in the Contract Documents, if these control devices are separately mounted they shall be furnished by the Plumbing Subcontractor and wired by Electrical Subcontractor in accordance with the manufacturer's wiring diagram, as shown on the drawings and as specified hereinafter.

1.22 IDENTIFICATION OF MATERIALS

A. All equipment used in the plumbing systems shall have a permanently attached nameplate identifying the manufacturer, service, size, serial number or model number, etc. The nameplates shall be kept clean and readable at all times.

B. Each item of equipment such as pumps, air compressors, vacuum pumps, etc., shall be identified by a permanently attached nameplate made of black surface, white core laminated bakelite with 1" high indented letters. Nameplates shall be minimum 5" long by 3" wide and bear the equipment name as designated in the specifications. Nameplates shall be as fabricated by Seton Nameplate Co., Atlantic Engraving Co., W.H. Brady Co., or approved equal. Attach with screws or rivets only.

C. A legend showing the service and an arrow indicating the direction of flow shall be applied on each pipe installed by the Plumbing Subcontractor. Indication shall be by stencil and paint only, no "stick-ons" will be allowed.

D. The piping of each system shall be identified in the following locations and where directed by the Architect.

1. Pipe mains and branches - every 15’-0”.
2. At each valve.
3. Each wall penetration (both sides).
4. Each riser including branch risers from mains.
5. At each piece of equipment.

E. The identification of piping shall be coordinated with the Owner and comply with OSHA and ANSI A13.1 Standards for the identification of systems. Obtain approval of Architect prior to installation. The letter size and background color shall conform to the ANSI Scheme for the Identification of Piping Systems.

F. Provide all labels on all vents thru roof.

G. Close attention shall be paid to all vent piping including that piping which penetrates roof. - This piping must be identified, including all vent penetration through the roof.

1.23 VALVE TAGS, NAMEPLATES AND CHARTS

A. All valves on pipes of every description shall be provided with neat circular brass valve tags of at least 1 1/2" in diameter, attached with brass hook to each valve stem or handle as determined by Architect. Tags shall be provided by the Plumbing Subcontractor for the work under his charge. Stamp on these valve tags, in letters as large as practical, the number of the valve and the service, such as "HW", "HWC", "CW", ", for hot water, hot water circulation, cold water. The numbers of each service shall be consecutive. Obtain approval of Architect prior to installation. All pipe system valves to be tagged.

B. All valves on equipment shall be numbered by 3" red metal discs with 2" high white numbers secured to stem of valves by means of brass hooks or small link brass chain.

C. These numbers shall correspond to numbers indicated for valves on the Record Drawings and on (2) printed detailed lists. These printed lists shall state the numbers and locations of each valve and the equipment or system which it controls and other necessary information such as requiring the opening or closing of another valve or valves when any one valve is to be opened and closed.

D. These printed lists shall be prepared in form to meet approval of the Architect and shall be framed under glass. Provide valve lists in booklet form also and submit (6) copies to the Architect.

E. Nameplates, catalog numbers and rating identification shall be securely attached to mechanical equipment with screws or rivets. Adhesives or cements will not be permitted.

F. The Plumbing Subcontractor shall provide for his work all valve charts including his name and telephone number; date of chart; name and telephone number of Architectural Firm and Consulting Mechanical Engineering Firm and the Owner's representative.

G. This information must be submitted on electronic file format also.

1.24 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

A. The Plumbing Subcontractor shall thoroughly instruct the Owner's operating personnel, to the complete satisfaction of the Architect, in the proper operation of all systems and equipment provided by him. The Plumbing Subcontractor shall make arrangements, via the Other Work Contractor, as to whom the instructions are to be given in the operation of the basic and auxiliary systems and the periods of time in which they are to be given. The Architect and Owner shall be completely satisfied that the Owner's representative has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by the Plumbing Subcontractor to the Owner's representative, then the Plumbing Subcontractor shall be

directed by the Architect to provide whatever instructions are necessary until the intent of this paragraph of the specification has been complied with. All time required for Owner's instruction to satisfy the above requirements shall be included in this Contract. No extra compensation for such instructions will be allowed.

B. The Plumbing Subcontractor shall submit to the Architect for approval, a total of (6) typed sets, bound neatly in 3-ring loose-leaf binders, of all instructions for the installation, operation, care and maintenance of all equipment and systems. Information shall indicate possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each section such as valves, water boosters, pure water systems, etc., shall be clearly divided from the other sections. A sub-index for each section shall also be provided. The methodology of setting-up the manuals shall be submitted to the Architect and Owner through the Contractor for approval prior to final submission of manuals.

C. The instructions shall contain information deemed necessary by the Architect and shall include, but not be limited, to the following:

1. Instructional classes on equipment and systems operation for Owner's representative and maintenance personnel, by engineering staff of Plumbing Subcontractor. Minimum of ten (10) hours of instruction. Instruction shall include:

   a. Explanation of manual and its use.
   b. Summary description of the plumbing systems.
   c. Purpose of systems.

   All training classes and equipment instruction shall be videotaped on VHS format by the Plumbing Subcontractor. Provide (3) copies of all tapes to the Owner and one to the Architect. At the Owner's discretion, the Plumbing Subcontractor provide ten (10) additional hours of instructions up to one year after the building has been occupied.

2. System

   a. Detailed description of all systems.
   b. Illustrations, schematics, block diagrams, catalog cuts and other exhibits.

3. Operations

   a. Complete detailed, step-by-step, sequential description of all phases of operation for all portions of the systems, including start-up, shutdown, adjusting and balancing. Include all posted instruction charts.

4. Maintenance

   a. Parts list and part numbers.

b. Maintenance, lubrication and replacement charts and Contractor's recommendations for preventive maintenance, as applicable to his work.
c. Troubleshooting charts for systems and components.
d. Instructions for testing each type of part.
e. Recommended list of on-hand spare parts.
f. Complete calibration instructions for all parts and entire systems.
g. Instruction for charging, filling, draining and purging, as applicable.
h. General or miscellaneous maintenance notes.

5. Manufacturer's Literature

a. Complete listing for all parts.
b. Names, addresses and telephone numbers.
c. Care and operation.
d. All and only pertinent brochures, illustrations, drawings, cuts, bulletins, technical data, certified performance charts and other literature with the model actually furnished to be clearly and conspicuously identified.
e. Internal wiring diagrams and engineering data sheets for all items and/or equipment furnished under each Contract.
f. Guarantee and warranty data.

6. The Plumbing Subcontractor shall furnish instructions for lubricating each piece of equipment installed by him. Instructions shall state type of lubricant, where and how frequently lubrication is required. Frame instructions under glass and hang in a location as directed by Architect.

7. Information must be submitted on electronic file also

1.25 MANUFACTURER'S REPRESENTATIVE

A. The Plumbing Subcontractor shall provide, at appropriate time or as directed by the Architect, the on-site services of a competent factory trained Engineer or authorized representative of particular manufacturer of equipment such as for the domestic water booster pump, ejectors, hot water heater, pumps, etc., provided under this Contract, to instruct the Owner, inspect, adjust and place in proper operating condition any item provided by him, as applicable. A minimum, system start-up shall start 90 days prior to scheduled building occupancy or at construction managers discretion.

B. The Plumbing Subcontractor, as applicable, shall start-up and set in operating condition all major equipment and systems, such as the domestic water booster pump, water heaters, ejectors, well water pumps, etc., in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. In no case will major systems and equipment be

activated by any of the Subcontractor's, without the assistance or presence of the equipment manufacturer representative.

C. A written report shall be issued by the particular equipment manufacturer and the Plumbing Subcontractor summarizing the results of the commissioning and performance of each system for the Architect's record. No additional compensation will be allowed for any Contractor for such services.

1.26 CONNECTIONS TO EQUIPMENT

A. The Plumbing Subcontractor shall provide all pipe connections to equipment provided under other Sections of the specifications as shown on the Architectural Planning, and/or plumbing drawings and herein specified (sterilizers, autoclaves, ice machines etc.), including final connections to equipment, to result in a complete system, fully operational. The Plumbing Subcontractor shall also make connections to Owner furnished or relocated equipment as specified above. Coordinate location of all equipment with Architect and Other Work Contractor. Obtain installation diagrams and methods of installation of all equipment, from manufacturers. Follow instructions strictly. If additional information is required, obtain same from Architect.

1.27 COORDINATION DRAWINGS

A. Before materials are purchased, fabricated or work is begun, each Subcontractor shall prepare coordination drawings for all floors/areas, including buried systems/services (all-Trade-composite at 3/8 inch scale), showing the size and location of his equipment and lines, in the manner described herein under General Requirements - Section 01040.

B. Coordination drawings are for the architect’s use during construction and shall not be construed as shop drawings or as replacing and shop drawings. The coordination drawings, when corrected for actual “as-built” conditions, will be reviewed by the Architect, corrected and become the Record Drawings to be submitted to the Owner for his use.

C. The cost of producing and reproducing the drawings will be included under the Contract of each Trade, including the cost or preparation of the Architectural building outlines. The HVAC Contractor shall take the lead to produce the Architectural backgrounds, show all ductwork, piping, etc., and circulate the drawings to any of his Subcontractors and the other Trades (Plumbing, Fire Protection, Electrical), so that they can indicate all their work as directed by the Architect as required, to result in a fully coordinated installation.

D. In addition to the regular coordination drawing review, the plumbing work will also be reviewed by the Architect/Engineer to ensure that the system and equipment arrangements are suitable to provide maintenance access and service as follows:

1. Valves and instrumentation should be grouped where possible and positioned in accessible locations.

E. Prepare a complete set of computer based AutoCad 2010 drawings at scale not less than 3/8" equals 1'-0", showing basic layout for the structure and other information as needed for preparation of Coordination Drawings. The drawings shall indicate the layout of all specialty tradework as indicated herein and shall be designated as Coordination Drawings. The Contractors can purchase a copy of the floor plans on disk from the engineer to assist in the preparation of Coordination Drawings. The Contractor shall provide a minimum of two (2) weeks notice to the engineer for the preparation of the disk. A signed liability release form will be required from the Contractor prior to the release of the disk from the engineer.

F. Highlight all fire rated partitions on the Coordination Drawings for appropriate coordination.

G. The main paths for the installation or removal of equipment from mechanical and electrical rooms shall be clearly indicated on the Coordination Drawings.

H. Each of the specialty trades shall add its work to the base drawings with appropriate elevations and grid dimensions. Specialty trade information shall be required for mechanical rooms, horizontal exits from plumbing closets, crossovers and for spaces in the above ceilings where congestion of work may occur such as corridors and, where required, entire floors. Drawings shall indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions and other services. Indicate elevations relative to finish floor for bottom of ductwork and piping and conduit 6" greater in diameter.

1. Specialty Trade shall include:

    a. Plumbing system.
    b. HVAC piping and equipment
    c. Electrical
    d. Sheet Metal Work
    e. Sprinkler System
    f. ATC system
    g. Medical/ Gas (Oxygen and Nitrous Oxide)
    h. Dental vacuum, Dental air system

I. Upon completing their portion of the Coordination Drawings, each specialty trade shall sign, date and return Coordination Drawings to the Contractor.

J. Where conflicts occur with placement of materials of various trades, the General Contractor shall be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialized and dated by the affected specialty trade subcontractor. The General Contractor shall then final date and sign each drawing.

K. Fabrication shall not start until Coordinate Drawings have been distributed to all parties as indicated herein.

L. Format: Coordination Drawings (plans only) shall be done using CAD in AutoCAD 2005 in either IBM or Mac Format, disks shall be given tot he architect for future transfer to Owner. Coordination Drawings will be used as base for as-built drawings.

M. Distribution of Coordination Drawings:

1. The General Contractor shall provide one print of each Coordination Drawing to:

   a. Each specialty trade Subcontractor.
   b. Owner
   c. Construction Manager
   d. Architect (for record purposes).

N. After distribution:

1. The method used to resolve interferences not previously identified shall be as in paragraph F. above. Distribute revised Coordination Drawings to all parties listed above.

O. Coordination Drawings include but are not necessarily limited to:

1. Structure
2. Partition/room layout, including indication of smoke and fire resistance rated partitions.
3. Ceiling layout and heights
4. Light fixtures.
5. Access Panels
6. Sheet metal, heating cols, boxes, grilles, diffusers, etc.
7. All heating piping and valves.
8. Smoke and fire dampers.
9. Soil, waste, vent piping, and conductor
10. All water systems.
11. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit. Motor control centers, starters and disconnects.
12. Sprinkler piping and heads.
13. All equipment, including items in the Contract as well as O.F.C.I. and O.F.I. items.
14. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur indicates areas in which the required access area may be greater than the suspected grid systems.
15. Medical Gas and Dental systems.

1.28 RECORD DRAWINGS

A. The Plumbing Subcontractor shall maintain current at the site a set of his drawings on which he shall accurately show the actual installation of all work provided under his Contract indicating any variation from the Contract Drawings, in accordance with the General Conditions and Supplementary General Conditions. Changes whether resulting from formal change orders or other instructions issued by the Architect shall be recorded. Include changes in sizes, location and dimensions of piping, equipment, etc.

B. Utilizing the coordination drawings described herein before, the Plumbing Subcontractor shall modify/correct/edit the plumbing work on the above CAD coordination drawings, to obtain a

"CAD" set of Record Drawings. Also include (2) blackline prints, and CDX CAD files of entire record drawings..

C. A marked-up and colored-up set of prints on-site will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner's representatives and they shall be corrected if found either inaccurate or incomplete. This procedure is mandatory.

D. Coordination drawings are for the Contractor's, Architects and Owner's use during construction and shall not be construed as replacing any shop drawings. The CAD coordination drawings, when corrected for actual "as-built" conditions, will be reviewed by the Architect, corrected and will be used to formulate the Record Drawings to be submitted to the Owner for his use.

E. The Plumbing Subcontractor shall submit a set of CAD files on disc marked "AS-BUILTS". All costs associated with the production and reproduction of the CAD files shall be included under the plumbing bid for work under the plumbing contracts.

1.29 ELECTRICAL ROOM REQUIREMENTS

A. The Plumbing Subcontractor shall not install any piping or equipment in or through electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms, unless piping or equipment is intended to serve these rooms. If the Plumbing Subcontractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.

B. Where piping carrying liquid or gas is routed to within 12" of any electrical panels or packaged equipment controllers, the Plumbing Subcontractor shall provide galvanized sheet metal drain pans below such piping. The drain pans shall be constructed of minimum 18 gauge G-90 galvanized sheet metal with all joints sealed watertight. Extend 1 1/4" copper drain piping, with dielectric union to nearest floor drain.

1.30 HOISTING EQUIPMENT AND MACHINERY

A. All hoisting equipment and machinery required for the proper and expeditious prosecution and progress of the work under this Contract shall be furnished, installed, operated and maintained in safe condition by the Plumbing Subcontractor for his material and/or equipment delivered to the designated hoisting area. All costs for hoisting operating services shall be borne by the Plumbing Subcontractor, for all equipment and work under his charge.

1.31 STAGING

A. All staging, exterior and interior for Plumbing work shall be furnished and erected by the Plumbing Subcontractor and maintained in safe condition by him for proper execution of his work.

1.32 SUBMITTALS

A. Prepare and submit shop drawings in accordance with the requirements hereinbefore specified, and of Division 0 and applicable parts of Division 1 and in the manner described therein, modified as noted hereinafter.

B. All shop drawings shall have clearly marked the appropriate specification number, drawing designation, project name, etc., for identification of the submittal.

C. Disposition of shop drawings shall not relieve the Plumbing Subcontractor from the responsibility for deviations from the drawings or specifications, unless he has submitted in writing a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Architect, nor shall such disposition of shop drawings relieve the Plumbing Subcontractor from responsibility for error in shop drawings or schedules.

D. Shop drawing data shall include, but not be limited to, the following:

1. Manufacturer's model and catalog data.
2. Complete connection diagrams for all Trades.
3. Dimensions, capacities, ratings, materials, finishes, etc.

E. Each shop drawing is required to bear the review stamp of each Contractor associated with installing the equipment and/or processing the document.

F. Shop drawings shall include, but shall not be limited to, the following:

1. Plumbing work layout, including location and sizes of piping, valves, drains, and all other accessories.
2. Equipment Cuts For:

a. Valves, gauges, drains, piping, fixtures, trim.
b. Hangers, supports, insulation, and identification.
c. Access panels.
d. Backflow prevention devices.
e. Domestic water heaters and circulation pumps.
f. Insulation
g. Seismic bracing
i. Mixing valves
j. Piping
k. Heat tracing
l. Water meters
m. Plumbing fixtures

1.33 TOILET ACCESSORIES

A. Attention is called to Division 10, the specialties section of the specification, specifically Section 102800 Toilet Accessories. All toilet room accessories, including grab bars at handicapped

fixtures, shall be furnished under Section 10800 of the Specifications. The labor for installing all toilet room accessories and all backup material of wood, fasteners, hangers, brackets, etc. shall be borne by the Plumbing Contractor. Reference shall be made to Architectural Specifications and drawings for exact quantity, type, elevation and locations of toilet accessories. Accessories must be properly fastened with special attention given handicapped persons grab bars, etc. which must be anchored in accordance with manufacturer's instructions. Store accessories until required on the job. Moving materials onto project site as required is the responsibility of this Subcontractor.

1.34 PIPE COVERING PROTECTOR

A. Where exposed pipe covering occurs on pipes rising and/or dropping to fixtures and equipment passing through floors, walls, partitions, and ceilings, there shall be installed in addition to the iron pipe size sleeve, a 24 gauge split pattern spun aluminum, stainless steel or chrome plated brass pipe covering protector at the ceiling, wall, bottom of the vertical drops and at the floor and shall rest on the pipe sleeve. The covering shall recede into those protectors at least 1-1/2", except where covering is to be carried all the way through sleeve. Provide protection saddles under all hangers.

1.35 CROSS AND INTERCONNECTIONS

A. No plumbing fixtures, equipment, device or piping shall be installed which will provide a cross or interconnection between a distributing supply or a drainage system or a soil or waste pipe which will permit or make possible the backflow of sewage, polluted water or waste into the domestic water supply system.

1.36 CORE DRILLING

A. This subcontractor shall perform all core drilling required for the proper installation of the plumbing system. Locate all required openings and prior to coring coordinate the opening with the General Contractor. Thoroughly investigate the existing conditions in the vicinity of the required opening prior to cutting. Care must be taken so as to not to disturb the existing hospital systems. Locate all other openings required for the General Contractor. All cored openings are to be by Plumbing Contractor and all other openings are by the General Contractor. Patching of existing walls and openings shall be preformed by the respective trade responsible for the finish material in which the opening is made.

B. All core drilling locations must be approved by the Owner.

PART 2 – MATERIALS

2.1 HANGERS AND SUPPORTS

A. All piping shall be supported from the building structure by means of approved hangers and supports. Piping shall be supported to maintain required grading and sloping of lines, to prevent vibration and to secure piping in place, and shall be so arranged as to provide for expansion and contraction.

B. Maximum spacing of hangers on runs of steel, copper or brass piping shall be as follows:

Schedule - Hanger Spacing in Feet/Pipe Material

Pipe Size (inches)	Steel	Copper or Brass
(a) ½	7	5
(b) ¾	7	5
(c) 1	7	5
(d) 1¼	10	6
(e) 1½	10	8
(f) 2	10	8
(g) 2½	12	10
(h) 3	12	10
(i) 4	12	10
(j) 5	12	10
(k) 6	12	10

C. Maximum spacing on cast iron soil pipe and acid resistant waste pipe shall be 5' and hangers shall be provided at all changes in direction. Hanger rods to support piping from the structure or supplementary steel shall not exceed 4' in total length. Where pipe support assemblies exceed 4' in total length, this Subcontractor shall furnish and install factory fabricated channels and associated accessories.

D. Where codes having jurisdiction require closer spacing, the hanger spacing shall be as required by code in lieu of the distances specified herein.

E. Hangers in general for all horizontal cast iron piping shall be clevis type hangers. These hangers shall be sized to provide for insulation protectors as hereinbefore specified.

F. Hangers for uncovered (un-insulated) copper and brass piping shall be factory applied plastic coated steel band.

G. Where three or more pipes are running parallel to each other, factory fabricated gang type hangers with the pipe saddle clips or rollers shall be used in lieu of the hereinbefore specified

clevis hangers. These hangers shall be sized to provide for insulation protectors as hereinafter specified. Pipe saddle clips shall be not less than 16-gauge metal and shall be plastic coated when installed with un-insulated copper piping or plastic piping. All piping to be supported from Unistrut type hanger.

H. All vertical drops and runouts, including insulated pipes, shall be supported by extension type split ring type hangers. These hangers shall be plastic coated when used on uncovered copper tubing or plastic piping. Supports on insulated piping shall be sized to fit the outside diameter of the pipe insulation.

I. Field painting or spraying of hangers in lieu of plastic coating will not be accepted.

J. All hangers on insulated lines shall be sized to fit the outside diameter of the pipe insulation. Provide pipe covering protection saddles at all hangers on the insulated lines.

K. Remove rust from all ferrous hanger equipment (hangers, rods and bolts) and apply one coat of zinc rich coating immediately after erection.

L. Piping at all equipment and control valves shall be supported to prevent strains or distortions in the connected equipment and control valves. Piping at equipment shall be supported to allow for removal of equipment, valves, and accessories with a minimum of dismantling and without requiring additional support after these items are removed.

M. All piping installed under this SECTION of the Specification shall be independently supported from the building structure and not from the piping, ductwork, or conduit of other trades. All supplementary steel, including factory fabricated channels, required to meet the requirements specified herein, shall be furnished and installed by this Subcontractor.

N. All hangers shall be secured to approved inserts or expansion shields wherever possible and practicable. Drilling where required shall be done by this Subcontractor under this SECTION of the Specifications. The use of explosives for driving shields and inserts is prohibited.

2.2 HOT WATER CIRCULATION PUMPS

A. Pumps: Furnish and install where shown on the plans, Bell & Gosset or TACO Mfg, duplex, all bronze horizontal centrifugal hot water circulation pumps for domestic water systems.

B. Control: Each pump shall be automatically controlled by a Minneapolis Honeywell, Marshall, or Powers Company, or approved equal L-4006A immersion aquastat which shall be installed in a suitable well, in the hot water circulation piping and shall be adjusted to start the circulating pumps at 5 degrees F above below or the normal operating temperature of the system. Thermometers shall be installed close to each aquastat with a 4 inch dial and range from 50

degrees F to 250 degrees F. Pumps shall have manual control also. Refer to hot water heater details.

C. Domestic Hot Water: 10gpm @ 12' head – 1/4 HP – 120-V, 1 phase.

2.3 DOMESTIC WATER HEATERS (DUPLEX)

A. Natural gas water heater(s) shall be A. O. Smith Cyclone Xi model # bth-120, with up to 96% thermal efficiency, a storage capacity of
60 gallons, an input rating of 120,000 BTUs per hour, a recovery rating of 138 gallons per hour (gph) at 100°F rise and a maximum hydrostatic
working pressure of 160 PSI.

B. Water heater(s) shall:
1. Have seamless glass lined steel tank construction, with glass lining applied to all water-side surfaces after the tank has been assembled and welded
2. Meet the thermal efficiency and standby loss requirements of the U. S. Department of Energy and current edition of ASHRAE/IESNA 90.1
3. Have foam insulation and a CSA Certified and ASME rated T&P relief valve;
4. Have a down-fired power burner designed for precise mixing of air and gas for optimum efficiency, requiring no special calibration on start-up;
5. Be approved for 0ß clearance to combustibles. Heater shall be supplied with maintenance-free powered anode.

C. The control shall be an integrated solid-state temperature and ignition control device with integral diagnostics, graphic user interface, fault history display, and shall have digital temperature readout.
1. The BTH-120 models are design-certified by CSA International, according to ANSI Z21.10.3 - CSA 4.3 standards governing storage-type water heaters.
2. Meet the thermal efficiency and standby loss requirements of the U. S. Department of Energy and current edition ASHRAE/IESNA 90.1. Complies with SCAQMD
Rule 1146.2 and other air quality management districts with similar requirements for low NO x emissions.

D. Power Direct Venting: Water heater(s) shall be suitable for power direct venting using a 4" diameter PVC pipe for a total distance of 120 equivalent feet of vent piping and 120 equivalent feet of intake air piping.

E. Provide all required termination vent kits at roof top.

2.4 INTERIOR VALVES FLANGES AND UNIONS

A. General: All systems under this Section shall be provided with valves to permit complete and/or sectional control of the system. They shall be located to permit easy operation, replacement and repair. They shall be installed where shown on the drawings, or as herein specified. They shall be the product of one manufacturer and shall be as manufactured by one of the following companies: Apollo, or Watts.

B. Water Valves

1. Water valves 2" and smaller shall be all bronze ball valves Apollo Series B-6800 with four bolt design, full port teflon seated ball and three piece valve body designed for 250 psi water.

2. Water valves larger than 2" and smaller than 3" shall be all bronze ball valves Apollo Series B-6400 with threaded ends designed for 250 pounds non-shock cold water.

3. Water valves 4" and larger shall be bronze mounted outside screw and yoke, solid wedge disc, flanged end Stockham F-667 250 iron body.

4. Drain valves shall consist of hose end drain valves, or ball valve with hose end adaptor, with bronze cap and chain.

5. Check valves shall be class 125 bronze bodied valves with bronze disc threaded cap, threaded ends by flanged ends where required by size.

6. Hot water circulation balancing valves shall be class 125 bronze with threaded ends. Globe valves with bronze discs, threaded cap. Flanged ends where required by size.

7. Provide reduced pressure backflow preventors as shown on the drawings, complete with control valves, repair kit, test kits, pressure gauges and air gap fittings, with drains piped to nearest floor drain. Valves shall be mounted 4'-0" centerline above the floor and properly secured to the wall or floor stand mounted. Devices shall be tested and certified under AWWA Std. No. C506 and FCCCHR of USC manual, Section 10.

a. Backflow preventor on main domestic water service shall be WILKINS Mfg reduced pressure zone device with FDA approved epoxy coated cast iron check valve bodies with bronze seats, FDA approved epoxy coated cast iron relief valve with stainless steel trim, bronze body ball valve test cocks, outside screw and yoke gate valves with resilient wedges and 909AG-K air gap fitting.

1) Main water service – 975 XL-5 – Containment/Inplant
2) Plumbing Equipment – 975 XL-5
3) Hot water application – 975 XL-5

8. In-line vacuum breakers for continuous pressure shall be Watts model N9C or approved equal, with bronze body, stainless steel working parts, rubber diaphragm and disc, 3/8" female inlet and outlet connections for in-line continuous pressure applications, polished chrome plated.

9. Backflow preventors with intermediate atmospheric vent shall be Watts 9D or approved equal all bronze construction with stainless steel internal parts, threaded union connections and built-in strainer, to be used for ice-maker connections and locations as called for on drawings.

C. Wall hydrants shall be Zurn-1310, with a chrome plated finish and integral backflow preventer.

D. Hose bibbs where indicated shall be chrome plated, hose and faucet valves with vacuum breakers, Chicago No. 952, or approved equal.

E. Trap primers for floor drains 2", 3" and 4" shall be Pro Set Trap Guard System. Refer to manufacturers requirements for installation. Contact vendor at Tower Hill Sales 1-800-542-5554. Except for mechanical rooms and open end drains.

F. Flanges shall be companion type, faced and drilled for not less than 125# steam working pressure except flanges on portions of the water service that are subjected to pressures above 125# shall be 250# rated, and all shall be complete with necessary adapter, and shall be of size and material of adjacent piping.

G. Unions shall be suitable for working pressure of not less than 250 psi and shall be of size and material of adjacent piping. All threads shall be IPS to match connections

H. Trap primer valves for Mechanical Room Areas floor drains and open end drains trap primer distribution unit shall be Precision Plumbing Products Mosel PO-500 Oregon No. 1 Trap Primer Unit with Distribution DU-4 and Supply Tube SS-8 serving 4 drains. Provide all interconnecting piping.

I. Water pressure reducing valves shall be Watts all bronze with diaphragm protector – see schedule on drawings.

J. Master Thermostatic Water Mixing Valve Assemblies shall be Powers– see schedule on drawings.

K. Check valves on elevator sump pumps shall be non-slam weighted valves with arms.

L. Natural gas shutoff valves 2” and smaller shall be Eclipse bronze ball valve, 150 psig maximum working pressure. Over 2” size natural gas shutoff valves shall be Eclipse lubricated plug cocks, 175 psig maximum working pressure. Check valves on natural gas piping shall be Jamesbury disc type check valves, brass body, screwed ends, aluminum soft seated disc.

2.5 ACCESS PANELS

A. Group together valves, cleanouts, etc., concealed in suspended ceilings, walls and furred spaces to reduce the number of access panels, but all valves must be freely accessible for maintenance.

B. Furnish access panels of proper size to service concealed vales and other items, but in no case less than 24" x 24". Panels shall be of the proper type for material in which they occur to be furnished by this contractor. Panels to be installed by the trade subcontractor in whose work the panels occur.

C. Panels shall have flush doors with #14 USCG steel door and trim #USCG steel frame, metal wings for fitting into construction, concealed hinges and screwdriver operated stainless steel cam lock. Panels shall be shop coated with two coats of zinc chromate primer.

2.6 WATER METERS

A. Meter shall be approved by the Portland Water District. Meter to be fitted with OS&Y gate valves with cast iron body and bronze trim. Meter shall be provided with remote readout device and modem. Plumber shall include all costs and fees in the price of the work to provide and install all required components.

B Provide water meters on irrigation if required and after HVAC backflow preventers serving HVAC equipment.

2.7 PIPE MATERIALS

A. Cast Iron Soil Pipe and Fittings - Above ground soil, waste and vent conductor piping.

1. American manufacture no-hub cast iron soil pipe and fittings conforming to ASTM A74. Joints to be made with couplings consisting of stainless steel shield and clamp assembly and elastomeric sealing sleeve. Clamps shall be ANACO – HUSKY – SD-4000.

B. Cast Iron Soil Pipe and Fittings-Buried soil, waste, vent and conductor piping.

1. American manufacture service weight cast iron soil pipe and fittings conforming to ASTM A74. Joints shall be made with rubber resilient gasket push-on joints.

C. Copper Tubing and Fittings (Type L) - Water Piping (Domestic and Non-Domestic water).

1. Tubing to be Type L hard temper conforming to ASTM Specification No. B88-78.

Fittings to be wrought copper conforming to ASTM B16.22. All joints shall be soldered with ASME Standard BWS/A5.8 lead free solder. Shall be used for all interior water piping.

2. May be used above ground for soil, waste and vent piping, and shall be used for forced main piping (unless noted on drawings) and shall be used for indirect waste piping and where space is limited or where called for on the drawings, except urinal waste piping shall remain cast iron. Fitting shall be made using 50-50 solder.

D. Ductile Iron Pipe and Fittings - Water Services

1. Thickness Class 52 cement lined ductile iron pipe conforming to AWWA C151-7, flanged ends.
2. Fittings shall be ductile iron, cement lined, 250 psi rating, flanged ends.
3. Shall be used for domestic water services outside of building. Shall be used for domestic service within building up to water meter for piping 8" in size.

E. Black Steel Piping and Fitting (Natural Gas)

1. Black steel pipe shall be Schedule 40 conforming to ASTM Designation A53 (seamless type). Fittings shall be black malleable (threaded or flanged) 150 pounds, conforming to ASA Designation B16.3. Shall be used for interior gas. Gas pipe dropping in concrete block walls shall be factory wrapped with corrosion resistant covering No. X-TRU coat or scotch kote.
2. All gas piping 4” and over and all buried gas piping shall joined by welded connections, except where detailed otherwise.

F. Stainless Steel Piping Pure Water System

1. Reverse osmosis pure water piping for sterilization and washing equipment shall be 316 stainless steel tubing with screwed fittings. All valves to be ball valve type.

2.8 DRAINAGE SPECIALTIES

A. Before setting any drains, carriers, cleanouts or wall plates, obtain from the other work contractor the exact information relative to the finished grades of the top of the drains and partition locations. All drainage specialties shall be of the size noted on the drawings and shall be equal to the figure numbers scheduled below. Figure numbers are Zurn Company. Drainage specialties shall be Zurn.

B. Off the floor water closets shall be supported on adjustable closet fittings Z-1200-XH-CC series as required with cast aluminum true wall finishing frame. Extra heavy duty carrier – 500 lb. with cast iron coupling.

C. Urinal Carriers

1. Urinals shall be supported on Zurn Z1221 plate type system with block base foot supports.

D. Lavatory Carriers

1. Lavatories slab type - shall be supported on Zurn Z1231 concealed arm system with chrome plated threaded escutcheons and block base foot supports.
2. NOTE: All carrier foot supports shall be lagged to the floor slab.

E. Floor Cleanouts

1. Floor cleanouts shall consist of dura-coated cast iron body, inside caulk outlet, tapered threaded plug, adjustable nickel bronze top, Zurn or approved equal.

For concrete floor - Zurn ZN1400
For vinyl composite tile - Zurn ZN1400-X
For carpeted areas - ZN1400-CM.
For heavy traffic unfinished areas Zurn Z-1400 with cast iron top.

F. Wall Cleanouts

1. Zurn Model ZS1469 cast iron supreme cleanout tee with tapered threaded plug, round stainless steel access cover with securing screw.

G. Floor Drains (FD)

1. SEE DRAWINGS FOR LOCATIONS AND SCHEDULE

H. Roof Drains (RD)

1. SEE DRAWINGS FOR LOCATIONS AND SCHEDULE

2.9 WATER HAMMER SHOCK ABSORBERS

A. Zurn Z1700 Series or approved equal - stainless steel "shoktrols" shall be installed on water supply lines to plumbing connected equipment equipped with fast acting valves, such as sterilizers autoclaves, all batteries of plumbing fixtures with flush valves and the like to control water hammer. They shall be sized and selected in accordance with PDI Standard WH201 with access through approved access panels.

2.10 INSULATION

A. All piping and equipment installed under this Contract shall be covered as follows:

1. All domestic and non domestic cold water.
2. All domestic and non domestic hot water supply and re-circulation.
3. All horizontal conductor piping
4. All tempered water piping
5. RO Piping to washers

B. Materials: The following materials are specified:

1. Water piping insulation - fiberglass.

2. Fittings and Valve Insulation:

   a. Hydraulic setting combination insulating and finishing cement.
   b. Molded or fabricated fitting covers of equal thickness and identical in composition to adjacent pipe insulation.

3. All materials, including vapor barrier jacket, glass cloth jackets, adhesives, etc., shall be fire retardant.

C. Insulation Thickness: The piping, fittings, and valves shall be insulated with the following minimum thicknesses:

1. Domestic and non domestic hot, circulating and tempered water piping, 3/4" thick up to 1" pipe size; over 1" pipe size shall be 1" thickness.

2. Domestic and non domestic cold water piping shall be 1/2" thick.

3. Horizontal conductor piping and waste piping below mechanical rooms and vertical drops from drain to offset and elbow at the end of the horizontal run, 1" thick with vapor barrier. Drainage piping, including drains may be insulated with two layers of vapor barrier blanket, 1" thick, minimum one pound density.

D. Finish:

1. Concealed Piping: Vapor barrier jacket on all water piping. Pre-sized glass cloth jacket may be used on hot water piping. Fittings shall be finished with pre-sized glass cloth jacket, PVC coverings, or fire retardant cloth.

2. Exposed Piping: Same as concealed, except all insulation shall have factory applied pre-sized glass cloth jacket, or all service jacket.

E. Application

1. General:

a. All insulation shall be installed in strict accordance with the manufacturer's recommendations and shall be applied by a qualified insulation contractor.

b. Coverings shall not be applied on any apparatus or piping until the apparatus and piping have been thoroughly cleaned, tested, and accepted as tight.

2. Piping: Pipe insulation shall be installed with vapor barrier jackets drawn tight and firmly sealed to assure a positive vapor seal. End joints shall be covered with 4 inch wide butt strips of material identical to vapor barrier jackets, and they shall be drawn tight and securely sealed. The use of staples, bands, etc., to secure insulation will not be accepted.

3. Fittings and Valves:

a. Cement or molded insulation on fittings and valve bodies shall be same thickness as adjacent covering and finish neatly to match the adjacent pipe insulation.

2.11 FIXTURES, EQUIPMENT, SUPPORTS, AND FASTENERS

A. All fixtures and equipment shall be supported and fastened in a satisfactory manner. Where wall hung fixtures are secured to masonry walls or partitions, they shall be fastened with 1/4" through bolts provided with nuts and washers at back. Bolt heads and nuts shall be hexagon and exposed bolts, nuts, washers and screws shall be chromium plated brass.

B. Where secured to concrete or brickwork walls, they shall be fastened with brass bolts or machine screws in lead sleeve type expansion shields and shall extend at least 3 inches into solid concrete brickwork.

C. Fixtures shall be American Standard Company and shall be installed complete with all trimmings and fittings as specified. Refer to architectural drawings for exact number and location of fixtures. Color of all fixtures to be white. Faucets shall be Delta Faucet unless noted.

D. Refer to the drawings for other fixture types and specifications.

2.12 SEISMIC BRACING

A. The Plumbing Subcontractor shall provide all necessary design and materials for seismic restraint and protection of piping and devices against damage where subject to earthquakes as required for the entire plumbing system within the building. All isolation and seismic devices shall be the product of a single manufacturer. Products of other manufacturers are acceptable provided their systems strictly comply with this section of the specifications. Provide isolation materials and seismic restraints complete and as manufactured by Mason Industries, Tolco or approved equal.

The work under this section shall include the design, furnishing and installation of all restraint devices and systems as may be required for the plumbing system including, but not necessarily limited to, the following:

1. All plumbing equipment and devices such as pumps, air compressors, tanks, etc.
2. All plumbing system piping as required.
3. Piping penetrations through floors and walls.
4. Sleeves with clearances around the outside, as recommended.
5. Equipment isolation bases.
6. Piping flexible connectors.
7. Seismic restraints for isolated equipment.
8. Seismic restraints for non-isolated equipment.
9. Certification of seismic restraint designs.

B. Submit ten (10) copies of descriptive data for all products and materials, including the following:

1. Catalog cuts and data sheets for the specific isolators, restraints and all other items to be utilized.
2. Details of methods of sleeving, plumbing, smokeproofing and isolation for pipes penetrating walls and slabs.
3. Specific details of seismic restraints and anchors, including number, size and locations for each piece of equipment.
4. Calculations to support seismic restraint designs.
5. All calculations, details and other submittal materials shall be sealed and signed by a structural or civil engineer registered in the state and qualified to perform seismic design calculations.
6. A seismic design liability insurance certificate that must accompany all submittals.

C. Code and standards requirements shall include, but not be limited to:

1. Applicable IBC with any additional State or Local requirements.
2. All State and Local codes.

D. Manufacturers working in this section must provide a seismic design liability insurance certificate and certify their ability to provide engineering and design as required by this section. This certificate shall be submitted to the Architect for review prior to any submittals.

2.13 BUILDING AUTOMATION SYSTEM

A The building automation system shall be furnished and installed under another section. This subcontractor shall provide dual contact pressure switches, tees, pipe wells, valves and caps to allow the connection from the BAS to the plumbing points required. The following table itemizes the equipment, location and type of device necessary to connect to the building automation system.

SERVICE OR EQUIP	PRESSURE	TEMP	FLOW	TROUBLE	CONTROL	LOCATION
Domestic Water Heaters		X			By BAS	Mech Rm Basement
Sewer Ejector Pumps				X	Contacts in Control Panel	Mech Rm Basement
Elevator Sump Pumps			X	X	Contacts in Control Panel	Elevator Machine Rooms
Water Service Entrance	X				By Bass	Mech Rm Basement
Building Hot Water		X			By Bass	Mech Rm Basement HW Mixing Valve
RO System				X	By Bass	2ed Floor

2.14 THERMOSTATIC MIXING VALVES

A. Furnish and install, as shown on the plans a thermostatic mixing valve for the domestic hot water systems as well as where shown on plans. Refer to drawings for schedule.

B. Provide bypass around all thermostatic mixing valve units.

2.15 ELECTRICAL CONTROL AND INTERLOCKING WIRING

A. The electrical contractor shall furnish and install power wiring 208 volt, 120 volt connection only to all plumbing connected equipment including panels and motors. This subcontractor shall mount panels and shall furnish and install all control and interlocking wiring for each piece of plumbing equipment including but not limited to local alarms for all plumbing equipment, pressure switches, flow switches and solenoid valves. All control wiring and interlocking wiring shall be installed in conduit and in accordance with the respective manufacturer's requirements and all connections shall be provided by the plumbing subcontractor. Wiring and conduit provided by this subcontractor shall be installed in accordance with the requirements of SECTION 16000 of the specifications.

B. All electrical panels and life support panels shall be equipped with connection for emergency power hook-up.

2.16 SEWAGE EJECTOR

A. Furnish and install One (1) Duplex set of WEIL Series 2422 submersible sump pumps. Each pump rated to deliver 40 GPM at 20' TDH. Pumps to have 300 SERIES stainless steel shafts and cast iron impellers, with carbon/ceramic mechanical seal.

B. Motors will be not less than 1 HP, 208 volt, 3 phase, 60 cycle 1750 RPM, with 20' of power cable. Motors shall be air-filled hermetically sealed dry running type. OIL FILLED MOTORS WILL NOT BE CONSIDERED EQUAL

C. The motors shall be housed in an air-filled watertight cast iron motor shell with the windings having Class 'F' insulation and pre-lubricated double seal bearings. The motor shaft shall be series 300 stainless steel with keyway for positive positioning and securing of the impeller. Motor end bell to be designed as a terminal box. Motors shall have automatic reset thermal overload protection.

D. Impellers: Cast iron, accurately machined to proper diameter and statically and dynamically balanced.

E. 4 – WEIL 8234 mechanical float switches, hermetically sealed, for suspension in sump basin. Each switch to have 20'of cable. Mercury switches are not acceptable.

F. 1 – NEMA 1 8158 Duplex control panel containing:
1 – Lockable panel disconnect, through-the-door with door interlock
2 – Lockable pump disconnects switches
2 - Magnetic starters with overload and single-phase protection
2 – TOA selector switches
2 – Pump run indicator lights
1 - Automatic alternator
1 – High water alarm horn w/silencer
1 - Set of isolated contacts for remote alarm
1 - Numbered and wired terminal strip

G. BASIN: 48" X 72" Deep fiberglass basin with inlet and anchor flange as required

H. BASIN COVER: 52" Square steel cover with all necessary openings

I. Each pump to have the WEIL PUMP 2613 Removal System.

2.17 WATER FILTRATION SYSTEM

A. The main entrance water filtration system shall be provided by the Plumbing Contractor. The system shall be a turnkey system and shall be provided and installed by American Aqua Systems

1-800-775-3993.

B. System components to include.
1- Twin alternating softener system connections 120 GPM normal flow-with commercial brine storage tank. Next to meter with all bronze construction.
2- 1000 Lbs. Solar salt
3- Auv-80-st-Ultraviolet disinfection unit- 3" SS Flange- 150 GPM with Ultraviolet intensity meter and probe.
4- AAS-7FOS3 SS canister housing -2" flange mounted with legs. DOE-5 micron filters 150 GPM Peak flow all 304 stainless construction.
5- Cases of polypro 5 micron 30" filters…20 per case.
6- Site assembly-Start up and staff in-service.

PART THREE - INSTALLATION

3.1 TESTING OF PIPING SYSTEMS

A. General

1. All piping systems shall be subjected to testing water, gas or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested, required head or pressure shall be maintained until all joints are inspected.
2. All tests shall be witnessed by the inspector having jurisdiction and the Architect/Engineer, with 48-hour notice given these authorities.
3. All equipment, material and labor required for testing any of the various systems or any part thereof shall be furnished by this Plumbing Subcontractor.

B. Sanitary, Waste and Vent, Roof Water Conductor Systems: Water test shall be applied to these drainage systems either in their entirety or in sections as required, after piping has been installed. If applied to the entire system, all openings in the piping system shall be tightly closed, except the highest opening, and the system filled with water to point of overflow. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section under test, and each section shall be filled with water but no section shall be tested with less than a 10' head of water. In testing successive sections at least the upper 10' of the next preceding section shall be tested so that no joint of piping in the building, except the uppermost 10' of the system, shall be submitted to a test of less than a 10' head of water. The water shall be kept in the system for at least 15 minutes before inspection starts; the system shall then be made tight at all points.

C. Any points of the drainage systems to be tested with air instead of water shall be made by attaching an air compressor testing apparatus to any suitable opening and after closing all other inlets or outlets, forcing air into the systems until there is a uniform gauge pressure of 5 psi or sufficient to balance a column of mercury 10" high. This pressure shall be held without the introduction of additional air for a period of at least 15 minutes.

D. All Water Piping Systems: Upon completion of all water supply systems or a section of them as required, they shall be tested and proved tight under a water pressure of 175 psi. Gauge should be located on the lowest new floor and pressure shall hold for a period of one hour without introducing additional water. The water used for testing shall be from a domestic water source of supply. Water piping before PRV’s and express riser set to 200 psi.

E. Defective Work: If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. All repairs to piping shall be made with new materials. No caulking of screwed joints or holes will be acceptable.

F. Provide 48-hour notice to hospital and authorities having jurisdiction of all test times, systems and procedures.

3.2 IDENTIFICATION

A. All labeling of piping, materials, and equipment, as outlined hereinafter for identification purposes, shall be performed by this Subcontractor.

B. The pipe markers shall be installed on the apparatus in full view and shall be a color that is in sharp contrast with the background. Color coding to be in accordance with the standards outlined in the American Hospital Association latest publication.

C. Before markers are applied, the apparatus shall be thoroughly cleaned and painted, if necessary.

D. Letters shall not be less than 1-1/2" in height. Arrows shall not be less than 9" long.

E. All water systems, sanitary piping systems exposed, above removable ceilings, and above furred spaces, shall be identified at intervals of approximately 20', at each change of direction and on both sides of walls for pipes passing through walls.

F. Piping systems shall be identified with approved snap-on covers designating services and direction of flow. Location of identification covers shall be near access panels wherever possible on both sides of valves. The markers shall be as manufactured by W.H. Brady Company, Westline Products, Seton Nameplate Company or approved equal.

G. Piping shall be labeled.

SYSTEM

Cold Water (Domestic and Non Domestic)
Hot Water (Domestic and Non Domestic)
Hot Water Circulation
Sanitary Waste
Roof Drainage
Tepid water to eye wash units
Ro Piping

3.3 CORE DRILLING

A. All core drilling required for the installation of the plumbing systems is to be done by this Plumbing Subcontractor. This Subcontractor is to carry all costs for core drilling. The Construction Manager will not be responsible for any circular penetrations required for the proper installation of the plumbing systems. Locate all required openings and prior to coring, coordinate the opening with the Construction Manager and all other trades. Thoroughly investigate the existing conditions in the vicinity of the required opening prior to coring. This Subcontractor

shall be responsible for damages to the building and its systems from the coring operations. Disturbances from coring shall be kept to a minimum.

3.4 SOIL, WASTE, VENT, AND CONDUCTOR PIPING

A. Pipes shall be plumb and parallel to building walls, beams, and columns. All horizontal lines are to be evenly pitched and properly secured with iron or steel hangers. A pitch of ¼" per lineal foot shall be maintained on all soil, waste, and conductor lines, wherever possible. Where long runs of piping require less pitch due to space restrictions, a less pitch shall be allowed on main lines 4" and over in size, but in no event should any pipeline have a slope less than 1/8” per lineal foot.

B. All soil pipelines shall be thoroughly put together with joints made with no-hub clamps. No hub clamps shall be torqued to manufacturer's recommendations.

C. All soil and waste pipes shall be carried out full size through the roof or connected to a common vent above the fixture and as shown on the drawings.

D. The main stacks of back ventilation shall run parallel and as close as possible to the soil pipe stacks and shall connect to the vent continuation of the soil stack at least 3" above the rim of the highest plumbing fixtures on the stack; vent stacks shall also be dripped into the bottom of the soil stack through a Y and _ bend on an upright Y fitting. Offsets in vent pipe shall be made with 45 degree fittings wherever possible. Horizontal vent lines shall pitch toward a waste line.

E. Threaded joints shall have American National taper screw thread with graphite and oil compound applied to the male threads.

F. Piping to be run straight and plumb and all offsets shall be made at an angle of not less than 45 degrees and all threaded joints shall be as specified above.

G. Carefully lay out the work in advance so that the pipes will pass through the opening and permit the proper pitch to the pipelines. Due to the extensive system of ventilation and lighting systems, it will be necessary for all trades to properly coordinate their work with the work of other trades so as to avoid the necessity of taking down work installed without prior checking.

3.5 CLEANOUTS

A. Provide and connect cleanouts with brass caps and screws same size as pipe up to 4" and not less than 4" for larger piping at the ends of all branches on soil and waste piping, and in such other portions of the piping where run is over 50 feet. Underfloor cleanouts shall be installed as detailed. Special attention is called to cleanouts in carpeted areas. Cleanouts shall have special carpet marker.

B. Where stacks enter drains near walls or piers causing difficult access to end cleanouts, there shall be a vertical cleanout on the stack just above the floor with a 1/4 bend at the foot of the stack.

C. Where such conditions occur in walls or partitions, the cleanout cover shall be accessible through an opening left in the wall and covered with the flush chromium plated brass plate or access panel securely fastened in place.

D. Where test tees are installed at the base of the stack, or on the stack, they may be used as a cleanout.

E. Brass cleanouts shall be solid nut construction.

F. Provide the Owner with six wrenches for removing flush cleanout plugs.

3.6 INTERIOR WATER PIPING

A. Test all water piping.

B. Pipe used in piping assembly must be clean of dirt and obstructions and shall have ends square and reamed before butting into the fittings.

C. Cut the tube to the required length with hacksaw or tube cutter designed for copper work.

D. Remove burrs from the inside and outside of the cut edge and clean the end of the tube with steel wool or sand cloth until all discoloration is removed and metal is smooth and bright.

E. Oxides will be removed by sand cloth, brush, etc.

F. Removal of oxides or discoloration of pipe and fittings by acids or self-cleaning flux is forbidden.

G. Apply a thin, uniform and complete coating of reliable brand of soldering flux meeting the ASME Standard BWS/A5.8, lead free to the cleaned surfaces of the tube and fittings.

H. When joints are soldered, remove excess solder with a cloth or brush leaving a fillet of solder in the chamber at the end of the fitting.

I. All piping must be true and plumb and with proper pitch for draining after soldering – **No Dead End Piping.**

J. All lines of water piping shall be protected from water hammer by air chambers and/or shock absorbers. Where air chambers are used, extend branch piping upward at least 20 times the diameter of the pipe. To install air chambers, pipe dropped into pipe spaces shall be carried full size as branches to fixtures with full size air chambers. Where shock absorbers (or shocks) are used, they shall be as manufactured by Josam Mfg. Co., JR Smith, or Zurn Mfg. Co., shall conform to the Plumbing and Drainage Institute published requirements and shall be made accessible through access panels.

L. Furnish and install all valves required to isolate sections of the piping system extending into areas scheduled for construction at a later date. Provide any and all draw-off valves which

may be required to properly chlorinate the system in sections as required by the phasing of the Building. Identify future isolation and phasing valves as such with valve tags and include same on charts and as-built drawings.

3.7 DISINFECTION OF ALL WATER SYSTEMS

A. General

1. All water piping systems shall be thoroughly disinfected with a solution containing not less than 50 parts per million of available chlorine by this Plumbing Subcontractor. The chlorinating material shall be either liquid chlorine or sodium hypo chlorite solution.

2. This work is to be supervised by the Owner's representative and performed by an Owner approved chemical testing laboratory and results sent to the Architect/Engineer or his representative for verification. All costs shall be borne by this Plumbing Subcontractor.

3. The testing laboratory shall submit a summary of the test procedure to the Owner for approval prior to any work being performed. All work to be in accordance with the Owner's requirements. This Plumbing Subcontractor shall provide any and all valves, pipe and connections required to disinfect the water supply system totally or in part as required. Provide isolating valves and draw-off valves for proper containment, phasing and flushing.

B. Procedure

1. The water systems shall be tested and thoroughly flushed prior to chlorination.

2. The chlorine shall be introduced at the point of the building water service for interior piping. The disinfection solution shall be allowed to remain in the system for a period of 24 hours, during which period all valves and faucets shall be opened and closed several times with the chlorine drawn to all points in the system. After disinfection, the solution shall be flushed from the system with potable water until the residual chlorine content is not greater than 0.2 parts per million. Prior to any further testing procedures, the Engineer and the Owner shall review all draw-off valve locations and chlorine introduction locations.

3. The Plumbing Subcontractor is to allow ample time for the chlorination of the water systems and is to plan the chlorination just prior to occupancy if possible. If the system is to sit dormant for any extended period of time prior to occupancy, the contractor is to flow water to all points in the building to completely flush the systems prior to

occupancy. A full three days notice will be given the Owner and Engineer prior to the start of disinfection.

C. Tests

1. The Owner's representative shall select two locations on each floor of each building for a chlorine concentration test. The Owner's representative shall select three locations on each floor for a chlorine residual, a coliform bacteria and total plate count bacteria tests. The laboratory report shall include sample locations, chlorine concentration, chlorine residual, coliform bacteria count and, after flushing, total plate count bacteria tests.

2. Acceptable limits for total plate count shall be 300 per 100 ml sample. Acceptable levels of chlorine residual shall be .2 PPM.

3. If these parameters are not met, continued flushing of the water systems shall be required until they are met.

4. Full Owner acceptance of the water systems shall not be given until these parameters are met, documented and submitted by the Testing Laboratory selected

3.8 PLUMBING CONNECTED EQUIPMENT

A. Furnish and install waste and vents, traps, protected cold water, protected hot water, domestic hot and cold water piping, and treated water piping as required including pipe stands and trim and all final connections to plumbing connected equipment furnished by others. Roughing for this equipment shall be as indicated on the drawings.

B. Furnish and install shutoff valves at each piece of equipment. Obtain exact roughing in dimensions from manufacturers of all service locations before connecting to or roughing for equipment.

C. Furnish and install backflow preventers, pressure reducing valves and vacuum breakers as required.

D. Sinks and equipment connected to by this Contractor but furnished and set under another section of the Specifications shall be identified on the drawings by SK (sink), etc., as opposed to a plumbing contractor furnished and installed fixtures indicated on the drawings by a "P" number. Coordinate casework and sink units with Section 11200.

3.9 NATURAL GAS SYSTEMS

A. Connect to new service where indicated with an approved shutoff valve and extend to the required points throughout the buildings. Obtain permits and defray all costs incidental to the

interior gas piping. Furnish and install all piping, stop valves and connections to all equipment and outlets requiring gas within the building.

B. A suitable drip or condensate pocket shall be installed at bottom of risers.

C. Gas piping and safety devices shall conform to the requirements of the NFPA Standard No. 54 and shall be subject to inspection and approval of the State Gas Regulatory Board.

E. Special Note: Furnish and install aluminum check valves in all gas pipes that enter rooms where compressed air is also installed or when both compressed air and gas piping connect to the same piece of equipment. This is required in all laboratories and areas where gas and air are present together.

F. Provide a gas cock valve at each branch runout from main or riser serving gas outlets.

G. All piping shall be securely fastened separately hung and shall not support any other weight or piping. Piping dropping in concrete block walls shall be factory wrapped for corrosion protection.

H. Gas valves or cocks shall not be concealed and shall be readily accessible for inspection and repair. All welded piping shall conform to the latest requirements of the National Fuel Gas Code.

END OF SECTION

SECTION 224800- DENTAL/**AIR** ~~MEDICAL GAS~~ AND VACUUM SYSTEMS

INDEX

SECTION 224800– DENTAL/ **AIR** ~~MEDICAL GAS~~ AND VACUUM SYSTEMS

PART ONE – GENERAL

1.1 REFERENCES

A. All of the Contract Documents, including General and any Supplementary Conditions and Division 1 – General Requirements, apply to the work of this section.

B. Examine all Drawings and all other Sections of the specifications for requirements therein affecting the work of this trade.

1.2 DEFINITIONS

A. Words in the singular shall also mean and include the plural, wherever the context so indicates and words in the plural shall mean the singular, wherever the context so indicates.

B. Wherever the terms "shown on drawings" are used in the specifications, they shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.

C. Wherever the term "provide" is used in the specifications it will mean "furnish" and "install", "connect", "apply", "erect", "construct", or similar terms, unless otherwise indicated in the specifications.

D. Wherever the term "material" is used in the specifications it will mean any "product", "equipment", "device", "assembly", or "item" required under the Contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.

E. The terms "approved", or "approval" shall mean the written approval of the Architect.

F. The term "specification" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, including all drawings.

G. The terms "directed", "required", "permitted", "ordered", "designated", "prescribed" and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect. The terms "approved", "acceptable", "satisfactory" and similar words shall mean approved by, acceptable or satisfactory to the Architect. The terms "necessary", "responsible", "proper", "correct" and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.

H. "Piping" includes in addition to pipe or mains, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

I. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.

J. "Exposed" means not installed underground or "concealed" as defined above.

K. "Plumbing Subcontractor" refers to the Subcontractor or his Subcontractors responsible for furnishing and installation of all work indicated in the medical gas specifications and as shown on the designated drawings.

1.3 SCOPE

A. Perform work and provide material and equipment as shown on the Designated Drawings and as specified or indicated in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide a complete and fully functional installation.

B. Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

C. Give notices, file plans, obtain permits and licenses, pay fees and obtain necessary approvals from all Authorities Have Jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings and Addenda all of which are part of these Contract Documents.

D. The Scope of the Work consists of the installation of all materials to be furnished under this Section, including all associated work required, and without limiting the generality thereof, to include:

All work in Section 220000 – Plumbing
Dental Vacuum piping system
Dental Air piping systems
Compressed Air piping system
~~Oxygen & Nitrous Oxide piping system~~
~~Medical Gas Alarms~~
~~Medical gas connections~~
Installation testing – ~~medical gas system~~ Dental Air system piping
Certification testing – ~~medical gas system~~ Dental Air system piping
Valves
Core drilling
Furnishing of access panels
Record drawings
Hangers, sleeves and appurtenances
Installation of firestopping & smokeproofing
Staging, scaffolding and rigging
Compressed Air equipment
Dental Air equipment
Vibration isolation
Dental Vacuum equipment
~~Medical gas connections to outlets~~
Seismic bracing
Building automation system
Control/interlocking wiring
Connection to owner furnished equipment

Dental Almagam separation system

E. The following work is not included in this Section and is to be performed under other Sections:

1. Cutting and patching.
2. Temporary water, facilities and controls.
3. Housekeeping pads, in concrete:
4. Flashing of all pipe penetrations.
5. Finish painting.
6. Plumbing work.
7. Heating, ventilating and air conditioning work.
8. Electrical power wiring.
9. Installation of access panels furnished under this Section shall be by the Trades as designated by the Construction Manager.
10. Temporary light, power, water, heat, and sanitary facilities for use during construction and testing.
11. Sprinkler system.
12. Fire alarm system and controls.
13. Furnishing or fire and smokeproofing materials.

1.4 CODES, STANDARDS AND REFERENCES

A. All materials and workmanship shall comply with all latest editions of applicable Codes, Local and State Requirements and requirements of all Authorities Having Jurisdiction, and these specifications.

B. In case of difference between any Regulations and the Contract Documents, the Medical Gas Subcontractor shall promptly notify the Architect in writing of any such difference.

C. In case of conflict between the Contract Documents and the requirements of any Code or requirements of any Authorities Having Jurisdiction, the most stringent requirements of the aforementioned shall govern. Plumbing Subcontractor shall promptly notify the Architect in writing of any such occurrence.

D. Should the Plumbing Subcontractor perform any work that does not comply with the requirements of the specifications and applicable Codes, he shall bear all costs arising in correcting the deficiencies to the satisfaction of the Architect.

E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations and the applicable requirements of the following accepted Codes and Standards, without limiting the number, as follows:

F. Applicable Codes

1. Local and state building, plumbing, mechanical, electrical, fire and health department codes.
2. National Fire Protection Association (NFPA)
3. Occupational Safety and Health Act (OSHA)
4. Underwriters' Laboratories (UL)
5. International Building Codes (IBC) 2006
6. NFPA-99 (2010)

G. In these specifications, references made to Code are intended to indicate the accepted volume or publication of the Standard or applicable Code. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:

1.	ANSI	American National Standards Institute
2.	ASME	American Society of Mechanical Engineers
3.	ASTM	American Society of Testing Materials
4.	AWS	American Welding Society
5.	CS	Commercial Standards, U.S. Department of Commerce
6.	MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
7.	NEMA	National Electrical Manufacturers Association
8.	UL	Underwriters' Laboratories, Inc.

H. Specific reference is made to the following NFPA codes which shall govern provision of work as specified and as required by codes and authorities.

1.	No. 72	National Fire Alarm Code
2.	No. 101	Life Safety Code
3.	No. 99	Health Care Facilities

I. The Plumbing Subcontractor for the work shall give all necessary notices, obtain and pay for all permits, pay all taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. The Plumbing Subcontractor shall obtain all required Certificates of Inspection for his work and deliver same to the Architect before request for acceptance of his portion of work is made and before final payment.

1.5 GUARANTEE

A. Attention is directed to provisions of the General Conditions and Supplementary General Conditions regarding guarantees and warranties for work under this Contract.

B. Manufacturers shall provide their standard guarantees for work under this Contract. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and Construction Manager may have by Law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the Medical Gas systems, as determined by the Architect and shall remain in effect for a period of one (1) year thereafter.

C. All materials, items of equipment and workmanship furnished under each Section shall carry the standard warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good,

forthwith, by and at the expense of the Plumbing Subcontractor including all other damage done to areas, materials and other systems resulting from this failure.

D. The Plumbing Subcontractor shall guarantee that all elements of the systems provided under his Contract, are sufficient to meet the specified performance requirements as set forth herein or as indicated.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the Plumbing Subcontractor within one (1) week at no cost to the Owner.

F. The Plumbing Subcontractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

G. Provide 24 hour service beginning on the date the project is first occupied, whether or not fully occupied, and lasting until the termination of the guarantee period. Service shall be at not cost to the Owner. Submit name and a phone number that will be answered on a 24 hour basis each day of the week, for the duration of the service.

H. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's satisfaction, advise Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Architect will determine course of action.

1.6 THE SUBCONTRACTOR

A. The Plumbing Subcontractor shall study all Contract Documents included under this Contract to determine exactly the extent of work provided under this Section, and in installing new equipment and systems and coordinating the work with the other Trades.

B. The Plumbing Subcontractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications.

C. The Plumbing Subcontractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed directly or indirectly by the Medical Gas Subcontractor shall perform their work according to all the conditions as set forth in these specifications.

D. The Plumbing Subcontractor shall furnish all materials and do all work in accordance with these specifications and any supplementary documents provided by the Architect. The work shall include every item shown on the drawings and/or required by the specifications as interpreted by the Architect. All work and materials furnished and installed shall be new and of the best quality and workmanship. The Plumbing Subcontractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed.

1.7 COORDINATION OF WORK

A. The Plumbing Subcontractor shall compare his drawings and specifications with those of other Trades and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the medical gas work. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, Plumbing Subcontractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the Medical Gas/Dental work caused by the Plumbing Subcontractor's neglect, shall be made by him at his own expense, to the Architect's satisfaction.

B. Locations of pipes and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. The Plumbing Subcontractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component.

C. Lines which pitch shall have the right-of-way over those which do not pitch. For example, waste piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.

D. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. All work shall be installed in a way to permit removal (without damage to other parts) of coils, filters, control appurtenances, fan shafts and wheels, filters, belt guards, sheaves and drives and all other system components provided under this Contract requiring periodic replacement or maintenance. All piping shall be arranged in a manner to clear the openings of swinging overhead access doors as well as ceiling tiles.

F. The Contract Drawings are diagrammatic only intending to show general runs and locations of piping, equipment, and specialties and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom. All changes required due to job conditions must be approved by the Architect prior to commencement of work.

G. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, alarm points, etc., such conflicts shall be reported to the Architect prior to signing of the Contract. If such action is not taken, the Plumbing Subcontractor shall furnish such items as part of his work as necessary, for complete and operable systems and equipment, as determined by the Architect.

H. Where drawing details, plans and/or specification requirements are in conflict and where pipe sizes of same pipe run is shown to be different between plans and/or between plans and sections or details, the most stringent requirement will be included in the Contract. ~~Medical Gas~~/Dental systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.

I. Final location of all alarm panels, alarms, gas outlets shall be coordinated with the Architectural plans and/or other Architectural details, as applicable. Offsets of piping, elbows, etc., shall be provided as required to comply with the architectural plans. Obtain approval of locations of all devices from Architect in the field.

J. Included as part of coordination the Plumbing Contractor shall maintain service and maintenance access around all medical gas equipment.

1.8 COORDINATION DRAWINGS

A. Before materials are purchased, fabricated or work is begun, each Subcontractor shall prepare coordination drawings for all floors/areas, including buried systems/services (all-Trade-composite at 3/8 inch scale), showing the size and location of his equipment and lines, in the manner described herein under General Requirements - Section 01040.

B. Coordination drawings are for the architect's use during construction and shall not be construed as shop drawings or as replacing and shop drawings. The coordination drawings, when corrected for actual "as-built" conditions, will be reviewed by the Architect, corrected and become the Record Drawings to be submitted to the Owner for his use.

C. The cost of producing and reproducing the drawings will be included under the Contract of each Trade, including the cost or preparation of the Architectural building outlines. The HVAC Contractor shall take the lead to produce the Architectural backgrounds, show all ductwork, piping, etc., and circulate the drawings to any of his Subcontractors and the other Trades (Plumbing, Fire Protection, Electrical), so that they can indicate all their work as directed by the Architect as required, to result in a fully coordinated installation.

D. In addition to the regular coordination drawing review, the medical gas work will also be reviewed by the Architect/Engineer to ensure that the system and equipment arrangements are suitable to provide maintenance access and service as follows:

1. Valves and instrumentation should be grouped where possible and positioned in accessible locations.

E. Prepare a complete set of computer based AutoCad 2010 drawings at scale not less than 3/8" equals 1'-0", showing basic layout for the structure and other information as needed for preparation of Coordination Drawings. The drawings shall indicate the layout of all specialty tradework as indicated herein and shall be designated as Coordination Drawings. The Contractors can purchase a copy of the floor plans on disk from the engineer to assist in the preparation of Coordination Drawings. The Contractor shall provide a minimum of two (2) weeks notice to the engineer for the preparation of the disk. A signed liability release form will be required from the Contractor prior to the release of the disk from the engineer.

F. Highlight all fire rated partitions on the Coordination Drawings for appropriate coordination.

G. The main paths for the installation of equipment from mechanical and electrical rooms shall be clearly indicated on the Coordination Drawings.

H. Each of the specialty trades shall add its work to the base drawings with appropriate elevations and grid dimensions. Specialty trade information shall be required for fan rooms and mechanical rooms, horizontal exits from duct shafts, crossovers and for spaces in the above ceilings where congestion of work may occur such as corridors and, where required, entire floors. Drawings shall indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions and other services. Indicate elevations relative to finish floor for bottom of ductwork and piping and conduit 2" greater in diameter.

1. Specialty Trade shall include:

a. Plumbing system.
b. HVAC piping and equipment
c. Electrical
d. Sheet Metal Work
e. Sprinkler System
f. ATC system
g. ~~Medical Gas~~/Dental Air piping system

I. Upon completing their portion of the Coordination Drawings, each specialty trade shall sign, date and return Coordination Drawings to the Contractor.

J. Where conflicts occur with placement of materials of various trades, the Construction Manager shall be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialized and dated by the affected specialty trade subcontractor. The Construction Manager shall then final date and sign each drawing.

K. Fabrication shall not start until Coordinate Drawings have been distributed to all parties as indicated herein.

L. Format: Coordination Drawings (plans only) shall be done using CAD in AutoCAD, 2010 in either IBM or Mac Format, disks shall be given to the architect for future transfer to Owner. Coordination Drawings will be used as base for as-built drawings.

M. Distribution of Coordination Drawings:

1. The General Contractor shall provide one print of each Coordination Drawing to:

a. Each specialty trade Subcontractor.
b. Owner
c. Construction Manager
d. Architect (for record purposes).

N. After distribution:

1. The method used to resolve interferences not previously identified shall be as in paragraph F. above. Distribute revised Coordination Drawings to all parties listed above.

O. Coordination Drawings include but are not necessarily limited to:

1. Structure
2. Partition/room layout, including indication of smoke and fire resistance rated partitions.
3. Ceiling layout and heights
4. Light fixtures.
5. Access Panels
6. Sheet metal, heating coils, boxes, grilles, diffusers, etc.
7. All heating piping and valves.
8. Smoke and fire dampers.
9. Soil, waste and vent piping.
10. Major water and gases.
11. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit. Motor control centers, starters and disconnects.
12. Sprinkler piping and heads.
13. All equipment, including items in the Contract as well as O.F.C.I. and O.F.I. items.
14. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur indicates areas in which the required access area may be greater than the suspected grid systems.
15. ~~Medical gas and vacuum.~~
16. Dental Vacuum & Dental Air Compressor Systems

1.9 GIVING INFORMATION

A. The Plumbing Subcontractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the Architect and other Subcontractors sufficiently in advance of the work so that all openings may be built in advance.

1.10 EQUIPMENT AND MATERIALS

A. Equipment and materials shall be delivered to the site and stored in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls, switches, etc., shall be stored in dry, heated spaces.

B. The Plumbing Subcontractor shall have his equipment tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned, polished thoroughly and turned over the Owner in a condition satisfactory to the Architect. Damage or defects developing before acceptance of the work shall be made good at the ~~Medical Gas~~ Plumbing Subcontractor's expense.

C. The Plumbing Subcontractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.

D. The manufacturers listed within this specification have been preselected for use on this project. No submittal will be accepted from a manufacturer other than specified. Should the Plumbing Subcontractor wish to propose a substitution during the bid period, such request shall be made in writing to the Architect, no less than seven (7) working days, prior to bid date. If substitutions are deemed acceptable, such items shall be issued on an Addendum, prior to bid due date. The above requirement is mandatory.

E. Manufacturers' directions shall be followed completely in the delivery, storage, protection and installation of any equipment. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's written instructions before proceeding with the work. Should the Medical Gas Subcontractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.

F. The Plumbing Subcontractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.

G. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of the Plumbing Subcontractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, the Plumbing Subcontractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Plumbing Subcontractor shall make all necessary changes in all affected related work provided under other Sections including location of roughing in connections by other Trades, electrical requirements, piping, supports, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.

H. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. Equipment and materials shall be products which will meet with the acceptance of the Authorities having jurisdiction over the work and as specified hereinbefore. Where such acceptance is contingent upon having the products listed or labeled by FM, UL or other testing laboratories, the products shall be so listed or labeled. Where no specific indication as to the type or quality of material or equipment is indicated, a first class standard article shall be provided.

I. All equipment of one type (such as valves, outlets, switches, etc.), shall be the product of one manufacturer, unless otherwise specified.

1.11 CUTTING AND PATCHING

A. All concrete and masonry equipment bases and pads, curbs, chases, pockets and openings required for the proper installation of the work under this Contract will be provided by the Construction Manager, using information, as shown on the drawings and/or as required and furnished by the Plumbing Subcontractor. At a minimum, concrete bases (housekeeping) pads shall be 4 inches high and extending 3 inches on all sides beyond equipment (for all base mounted equipment).

B. In addition to the requirements outlined herein for cutting and patching, the Medical Gas Subcontractor shall be responsible for core drilling all holes required for work under his Contract and with the written approval of the Architect.

C. In no case shall the Plumbing Subcontractor cut into any structural elements without the written approval of the Architect.

1.12 USE OF PREMISES

A. The Plumbing Subcontractor shall confine all of his apparatus and storage of materials and construction to the work area or limits as directed by the Architect and he shall not encumber the premises with his materials.

B. In storing materials within areas (structure or ground), or when used as a shop, the Plumbing Subcontractor shall consult with the Construction Manager and shall restrict his storage to space designated for such purposes. The Plumbing Subcontractor will be held responsible for repairs, loss, patching or cleaning arising from any unauthorized use of premises.

C. Notwithstanding any approvals or instructions which must be obtained by the Fire Protection Subcontractor from the Architect in connection with use of premises, the responsibility for the safe working conditions at the site shall remain the Plumbing Subcontractor's and the Architect or Owner shall not be deemed to have any responsibility or liability in connection therewith.

1.13 PROTECTION

A. All materials such as valves, fittings, piping etc., shall be properly protected and all piping openings shall be temporarily closed by the Plumbing Subcontractor installing same, so to prevent obstruction and damage. To protect the equipment, temporary covers of substantial nature shall be provided to assure that items such as alarm panels, outlets, valves, etc., are not damaged. The Plumbing Subcontractor shall take precautions to protect his materials from damage and theft.
Plumbing Subcontractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or systems provided under his Contract.

1.14 DAMAGE TO OTHER WORK, CORRECTION OF WORK AND EXTRA WORK

A. The Plumbing Subcontractor shall be held responsible and shall pay for all damages caused by his work to the building structure, equipment, piping, duct systems, etc., and all work and finishes installed under this Contract in the building. Repair of such damage shall be done as herein before specified, at the expense of the Plumbing Subcontractor and to the Architect's satisfaction.

B. The Plumbing Subcontractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after completion of work and whether or not fabricated, installed or completed. The Plumbing Subcontractor shall bear all costs of correcting such rejected work.

C. No claim for extra work will be allowed unless it is authorized by the Architect in writing before commencement of the extra said work.

1.15 PIPE SLEEVES, PLATES AND ESCUTCHEONS, FIRE STOPPING AND SMOKEPROOFING

A. Where pipes pass through all walls or floors, the Plumbing Subcontractor shall provide and set individual sleeves for each pipe and all other work under his charge, as necessary for passage of all pipes. Sleeves shall be of sufficient size to provide 1/2 inch air space around the pipe passing through it. All openings shall be sealed, smokeproofed and made tight. The Plumbing Subcontractor shall be responsible for the exact location of sleeves provided under this Contract and shall coordinate all requirements for piping sleeves.

B. The Plumbing Subcontractor, for work under his charge, shall determine the diameter of each individual wall opening or sleeve before ordering, fabrication or installation.

C. Sleeves and inserts shall not be used in any portions of the building, where their use would impair the strength or construction features of the building. Elimination of sleeves must be approved by the Architect.

D. Provide chrome-plated brass escutcheons with set screw for exposed piping, in all areas. In mechanical rooms use plain brass or cast iron escutcheons suitable for painting. All escutcheons shall be sized to fit the bare pipe or insulation in a snug and neat manner. They shall be of sufficient size to cover sleeved openings for the pipes and of sufficient depth to cover sleeves projecting above floors. Escutcheons shall be as manufactured by Beaton and Caldwell, Dearborn Brass or Grinnell.

E. Exterior wall sleeve through masonry walls shall be made water tight by the use of Mechanical Link Seal.

F. Pipe sleeves shall be required on all pipes passing through all walls and shall be made of Schedule 40 pipe, 16 gauge galvanized steel or 16 gauge steel as follows:

1. Sleeves on pipes passing through masonry or concrete construction shall be Schedule 40 pipe.

2. Sleeves passing through masonry partitions shall be 16 gauge steel unless required otherwise by item 1. above.

3. Sleeves on pipes passing through drywall construction shall be 16 gauge galvanized steel.

4. Sleeves on pipes passing through fire rated drywall partitions shall be 16 gauge steel.

G. Pipe sleeves shall be set as follows:

1. Set sleeves 1 inch above finish floor (6 inches at penthouses and mechanical rooms) and flush on each side of walls, except sleeves through floor occurring in walls and partitions shall terminate flush with finish floor.

2. Sleeves shall be set securely in place before concrete is poured.

H. The Plumbing Subcontractor shall firestop or smokestop the space between the sleeves provided under his Contract and pipes as applicable, as required by General Conditions.

1.16 WATERPROOFING, FLASHING AND COUNTERFLASHING

A. Unless specifically indicated otherwise, the Plumbing Subcontractor shall provide all counterflashing and waterproofing of all piping, and equipment provided by him, which pierce roofs, walls and other weather barrier surfaces. All work under this paragraph shall be coordinated with the Construction Manager.

B. All work shall be performed in a workmanlike manner to assure weatherproof installation. Any leaks developed due to this Subcontractor's work shall be repaired at his expense, to the Architect's satisfaction.

C. Pipes passing through slabs shall have the sleeve extended above floors as hereinbefore specified to retain any water and the space between the pipe and sleeve caulked with lead wool. The top shall be sealed with lead and the bottom shall be sealed with monolastic caulking compound. The space between the outside of the sleeve and the floor slab shall be caulked watertight sufficiently to hold 2 inches of standing water.

D. All flashing required for piping penetrations shall be provided by the Construction Manager.

1.17 MISCELLANEOUS IRON AND STEEL

A. The Plumbing Subcontractor shall provide all steel supports and hangers as shown on the drawings and/or required to support all Plumbing equipment, systems and materials provided under this Contract.

B. All work shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets and framework shall be properly sized and strongly constructed.

C. Measurements shall be taken on the job and worked out to suit adjoining and connecting work. Members shall be straight, true and accurately fitted.

D. Drilling, cutting and fitting shall be done as required to properly install the work and accommodate the work of other Trades as directed by them.

E. Members shall be generally welded except that bolting may be used for field assembly where welding would be impractical.

F. All shop and field fabricated iron and steel work shall be cleaned and dried and given a coat of rust inhibiting paint on all surfaces and in all openings and crevices.

1.18 ELECTRICAL WORK, MOTORS, MOTOR CONTROLLERS

A. All electrical apparatus and controls furnished as a part of the Medical Gas work shall conform to applicable requirements under Electrical Section.

B. The Plumbing Subcontractor shall provide the Electrical Subcontractor with all electrical requirements within thirty (30) days from date of Contract to allow proper coordination of Trades by the Construction Manager.

C. The Plumbing Subcontractor shall verify with the Electrical Subcontractor available electrical characteristics before ordering any equipment or motors.

1.19 IDENTIFICATION OF MATERIALS

A. All equipment used in the Plumbing systems shall have a permanently attached nameplate identifying the manufacturer, service, size, serial number or model number, etc. The nameplates shall be kept clean and readable at all times.

B. Each item of equipment not provided with a manufacturer's nameplate, shall be identified by a permanently attached nameplate made of black surface, white core laminated bakelite with 1 inch high indented letters. Nameplates shall be minimum of 5 inches long by 3 inches wide and bear the equipment name as designated in the equipment schedules or the specifications. Nameplates shall be as fabricated by Seton Nameplate Company, Atlantic Engraving Company, W.H. Brady Company or approved equal.

C. A legend showing the service and an arrow indicating the direction of flow shall be applied on each pipe installed by the Plumbing Subcontractor.

D. The piping shall be identified in the following locations and where directed by the Architect.

1. Pipe mains and branches every 15 feet.
2. At each valve.
3. Each wall penetration (both sides).
4. Each riser including branch risers from mains.
5. At each piece of equipment.
6. As required by NFPA-99 (2010)

E. The identification of piping shall be coordinated with the Owner. Obtain approval of Architect prior to installation. The letter size and background color shall conform to the ANSI Scheme for the Identification of Piping Systems (ANSI 13 latest amendment) and the Hospital Standards.

F. Submit color code samples of each I.D. system.

1.20 VALVE TAGS, NAMEPLATES AND CHARTS

A. All valves on pipes of every description installed by the Plumbing Subcontractor, shall be provided with neat circular brass valve tags of at least 1 1/2 inches in diameter, attached with brass hook to each valve stem or handle. Tags shall have stamped on, in letters as large as practical, the number of the valve and the service. The numbers of each service shall be consecutive. Obtain approval of Architect prior to installation.

B. All numbers utilized shall correspond to numbers indicated for valves on the Record Drawings and on two (2) printed detailed lists. These printed lists shall state the numbers and locations of each valve and the equipment or system which it controls and other necessary information such as requiring the opening or closing of another valve or valves when any one valve is to be opened and closed.

C. These printed lists shall be prepared in form to meet approval of the Architect and shall be framed under glass.

D. The Plumbing Subcontractor shall provide for his work all valve charts including Plumbing Subcontractor's name and telephone number; date of chart; name and telephone number of Architectural Firm and Consulting Engineering Firm.

1.21 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

A. Refer to Section 01800 of Division 1 - General requirements for the requirements of this Section.

1.22 MANUFACTURER'S REPRESENTATIVE AND START-UP OF SYSTEMS

A. The Plumbing Subcontractor shall provide, at appropriate time or as directed by the Architect, the onsite services of a competent factory trained Engineer or authorized representative of particular manufacturer of equipment to instruct the Owner, inspect, adjust, test and place in proper operating condition any item provided by him, as applicable.

B. The Plumbing Subcontractor, as applicable, shall commission and set in operating condition all major equipment and systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. In no case will major systems and equipment be commissioned by any of the Subcontractor's forces alone, without the assistance or presence of the equipment manufacturers.

C. A written report shall be issued by the particular equipment manufacturer and the Plumbing Subcontractor summarizing the results of the commissioning and performance of each system for the Architect's record. No additional compensation will be allowed for any Subcontractor for such services.

1.23 ELECTRICAL ROOM REQUIREMENTS

A. The Plumbing Subcontractor shall not install any piping, or equipment in or through electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms, unless piping, or equipment is intended to serve these rooms. Additionally, no piping will be installed above electric panels or within the limits of any Code requirements. If the Plumbing Subcontractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.

1.24 RECORD DRAWINGS

A. The Plumbing Subcontractor shall maintain current at the site a set of his drawings on which he shall accurately show the actual installation of all work provided under his Contract indicating any variation from the Contract Drawings, in accordance with the General Conditions and Supplementary General Conditions. Changes whether resulting from formal change orders or other instructions issued by the architect shall be recorded. Include changes in sizes, location and dimensions of piping, equipment, etc.

B. Utilizing the coordination drawings described herein before, the Plumbing Subcontractor shall modify/correct/edit the Medical Gas/Dental work on the above CAD coordination drawings, to obtain a “CAD” set of Record Drawings. Provide (2) blackline prints and (2) copies of record drawings CAD files.

C. A marked-up and colored-up set of prints on-site will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner’s representatives and they shall be corrected if found either inaccurate or incomplete. This procedure is mandatory.

D. Coordination drawings are for the Contractor’s, Architect’s, and Owner’s use during construction and shall not be construed as replacing any shop drawings. The cad coordination drawings, when corrected for actual “as-built” conditions, will be reviewed by the Architect, corrected and will be used to formulate the Record Drawings to be submitted to the Owner for his use.

E. The Plumbing Subcontractor shall submit a set of CAD files on disc marked "AS-BUILTS". All costs associated with the production and reproduction of the CAD files shall be included under the Medical Gas bid for work under the fire protection contracts.

1.25 HOISTING EQUIPMENT AND MACHINERY

A. Refer to Division 1 - General Requirements for the requirements of this Section.

1.26 STAGING

A. Refer to Division 1 - General Requirements for the requirements of this Section.

1.27 SUBMITTALS

A. Shop drawing submittals shall be prepared and submitted as described herein and in accordance with Section 01330 - Division 1 - General Requirements and as modified and noted hereinafter.

B. Disposition of shop drawings shall not relieve the Medical Gas Subcontractor from the responsibility for deviations from drawings or specifications, unless he has submitted in writing a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Architect, nor shall such disposition of shop drawings relieve the Plumbing Subcontractor from responsibility for errors in shop drawings or schedules.

C. Submittal Procedures and Format

1. Review submittal packages for compliance with Contract Documents and then submit to Architect for review.
2. Verify quantities and type of medium to be submitted as outlined in Section 013300.
3. Each Shop Drawing shall indicate in title block, and each Product Data package shall indicate on cover sheet, the following information:
4. Title.
5. Name and location of project.
6. Names of Architect, Engineer, Contractor and Subcontractor(s).
7. Names of manufacturer, supplier, vendor, etc.
8. Date of submittal.
9. Whether original submittal or resubmitted.
10. Verify scale and type of drawings required.
11. Shop Drawings showing layouts of systems shall contain sufficient plans, elevations, sections, details and schematics to describe work clearly. They shall be minimum 1/8" = 1'0" scale unless specified otherwise. Provide larger scale details as necessary.
12. All firewalls and smoke partitions must be highlighted on the drawings for appropriate coordination.
13. Shop drawings showing manufacturer's product data shall contain detailed dimensional drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data, alone, is not

acceptable), electrical requirements and wiring diagrams. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.

D. Shop drawings shall include but shall not be limited to the following:

1. Medical Gas/Dental work layout, including location and sizes of piping, outlets, equipment, connections, drains, test stations, alarm panels, and all other accessories as required by NFPA 99 (2010).

2. Equipment Cuts For:

a. Alarm panels.
b. Medical Gas outlets.
c. Equipment.
d. Valves, gauges, drains, piping.
e. Hangers, supports.
f. Pressure switches, pressure sensors.
g. Access panels.

1.28 SITE VISIT

A. Before commencing any work under this section, verify all governing dimensions, elevations and locations at the building and examine all adjoining work on which this work is in any way dependent for its perfect efficiency according to the intent of these specifications. Visit and investigate all spaces and conditions to become familiar with installation and all requirements prior to bidding.

B. Each bidder shall visit the site and inspect all conditions affecting any aspect of the work. Failure to do so and misinterpretation of the plans and specifications resulting therefrom shall be entirely the responsibility of the bidder.

1.29 CORE DRILLING

A. This subcontractor shall perform all core drilling required for the proper installation of the Medical Gas system. Locate all required openings and prior to coring coordinate the opening with the General Contractor . Thoroughly investigate the existing conditions in the vicinity of the required opening prior to cutting. Care must be taken so as to not to disturb the existing hospital systems. Locate all other openings required for the Construction Manager. All cored openings are to be by Plumbing Contractor and all other openings are by the General Contractor. Patching of existing walls and openings shall be preformed by the respective trade responsible for the finish material in which the opening is made. Maximum core diameter is 12”.

B. All core drilling locations must be approved by the Owner.

1.30 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Instruct to the Owner’s satisfaction such persons as the Owner designated, in the proper operation and maintenance of all Medical Gas/Dental Vacuum systems and equipment and their parts.

B. Furnish operating and maintenance manuals prior to instructions and forward same to the Architect for transmittal to the Owner.

C. This Contractor shall give detailed instructions for a period of not less than 10 days, straight time, to the responsible personnel designated by the Owner in the operation and maintenance of all systems and equipment furnished under this Contract. A letter with five copies containing the name of the person or persons to whom the instructions were given and the dates of instruction period shall be submitted to the Architect/Engineer. Start-up and testing of all equipment supplied by this Contractor shall be performed by authorized factory representatives supplying equipment. Notification of this work must be given to the Owner.

D. This Contractor shall submit to the Architect/Engineer for approval four sets of operating and instruction manuals, spare parts lists, drawings, manufacturer's bulletins and other pertinent data on all equipment furnished under this Contract. Each set shall be enclosed in a suitable hard cover binder. This information must be submitted to the Owner when systems are approximately 90% complete to allow for proper review and familiaration prior to final instruction.

E. Provide name, address, and telephone numbers of manufacturer's representative and service company for each piece of equipment so that service parts can be readily obtained.

F. Upon completion of instructions this Subcontractor shall provide step by step typed procedures to test and operate each piece of equipment including detailed cross referenced drawings to procedure outlined so that all equipment may be tested, shut down, turned on or bypassed by the Owner's representative.

G. Provide a start up video with step-by-step audio instructions at start up and turnover to Owner.

PART TWO – PRODUCTS

2.1 ~~MEDICAL GAS~~, DENTAL AIR PIPING AND FITTINGS

A. All pipe and fittings shall be specially cleaned and prepared for medical oxygen service by the manufacturer or by a cleaning service company and received sealed on the job. Each length of tube shall be permanently labeled and delivered plugged and capped. Each fitting shall be individually sealed and marked. The Contractor shall furnish documentation from the manufacturer or cleaning service certifying that all piping materials comply with the requirements of this paragraph. The intent of this paragraph is for all materials to be directly delivered to the construction site from the manufacturer or cleaning service.

B. ~~Medical gas (oxygen & nitrous oxide) piping shall be ASTM B819 Type "L" hard drawn seamless copper tube. Piping shall be stamped as per NFPA-99.~~

C. Dental Air Piping and intake manifold relief vents shall be ASTM B88, B280 or B819 Type "L" hard drawn copper tube. Piping shall be stamped as per NFPA-99.

D. Fittings: for copper tubing shall be wrought copper pressure fittings, designed expressly for brazing at temperature greater than 1000°F and comply with ANSI B16.22.

E. Brazing Alloy: for assembling braze-joint fittings shall be Copper-Phosphorous-Silver Brazing (BCuP series) alloy and comply with ANSI/AWS A5.8. Flux shall not be used.

F. Threaded Connections: shall be made with fittings described above and shall be made up with Polythetrafluorethylene (such as Teflon) tape. Brush on sealants shall not be used.

G. Shall be used for Dental Air piping, Dental Air Intake except shall be type K..

H. ~~Dental Vacuum Piping shall be used for compressed air piping system and will be type K.~~

~~2.2 DENTAL VACUUM PIPING AND FITTINGS~~

2.3 ~~MEDICAL GAS~~ AND DENTAL AIR VALVES AND GAUGES

A. All valves and gauges shall be specially cleaned and prepared for medical oxygen service by the manufacturer. Valves and gauges shall be supplied to the job site in individual sealed containers and cleaned for medical oxygen service. The contractor shall furnish documentation certifying that all valves and gauges comply with the requirements of this paragraph.

B. Main, Riser, Isolation and Section Valves

1. ½" through 3" shall be AMICO Series # VV-ISO-G2L-XX, full port (3) piece ball valve with threaded connection, lockable handles, extensions and gauge port on both sides of the valve.

C. ~~Zone Valves (MGCV)~~

1. ~~Shall be AMICO # Series shutoff valves and valve boxes with threaded connection, extensions, gauge port and gauge.~~
2. ~~Refer to drawings for location and sizes of valves and specification info.~~
3. ~~Refer to drawings for detail showing piping of medical gas and vacuum zone valves~~.
4. ~~This Subcontractor shall provide required "labeling" of MGCV that satisfies NFPA. Submit sample for approval. Labeling shall indicate rooms or areas controlled by each valve~~.

D. Gauges

1. Main line pneumatic gauges shall be AMICO # P-500-Guage-K-xxx. Gauge face shall read 0-100 PSI for all pressure gases, vacuum gauge face shall read 0-30" Hg.
2. Provide and install ball valves and medical gas check valves prior to all gauges.

2.4 ~~MEDICAL GAS ALARM SYSTEMS~~

A. ~~General~~

1. ~~The medical gas alarm system shall be AMICO A2M-E-20.~~
2. ~~The Alarms shall comply with NFPA 99 (2010)~~
3. ~~The Alarm Network is a fully electronic monitoring system. It monitors and displays the status of all piped gas systems by using Master Alarms, Area Alarms, and Local Alarms that monitor the following:~~

~~Medical gas supplies; Mainline pressure; Area zone pressure and Master Alarm points.~~

B. ~~Area Alarms:~~

1. ~~The Area Alarm shall continuously display the actual pressure of the type of gas being monitored, unless there is an alarm error. In that case, the error code displays~~.

2. ~~The alarm shall provide separate Normal, High and Low LED indicators on each module: a green LED is used for Normal Conditions and red LED's are used for High and Low alarm conditions. An audible alarm is mounted on the P.C. Board inside the front panel~~.

3. ~~During normal operation, the Test Key on each module starts a self-diagnostic routine of the seven segment displays, the LEDs, and the audible alarm~~.

4. ~~Pressure lines are remotely monitored by gas specific transducers. The transducers are provided with the Area Alarm, are gas specific and include DISS gas specific demand valve installed at the factory~~.

5. ~~Transducers shall transmit a digital signal to their respective gas-specific Area Alarm Modules by using up to 4500' of stranded, 22-gauge, shielded, twisted-pair cable. Transducers shall receive their power from their respective Area Alarm Modules~~.

6. ~~Transducers shall be housed in a transparent enclosure and have an LED inside the housing used to indicate proper function~~.

7. ~~Transducers not connected to the appropriate gas-specific Area Alarm Module shall transmit an error message to the Area Alarm Module display~~.

8. ~~Transducers not performing properly shall transmit an error message to its respective Area Alarm Module display~~.

9. ~~The alarm shall be configured to the NFPA 99 (2010) standard values at the factory, but are field adjustable for high and low alarm set points. Pressing the increment/decrement keys displays the pressure set points~~.

10. ~~The Area Alarm has as an optional network communications board that interfaces with the facility's Ethernet via switch or hub. This allows a user to browse and configure the Area Alarm by using a personal computer that is logged onto the facility's Ethernet. Area alarm can also be configured from face of unit without use of computer. Refer to plans for locations~~.

11. ~~The Area Alarm Panels to be AMICO~~.

2.5 ~~MEDICAL GAS OUTLETS~~

A. ~~Medical Gas Outlets shall be AMICO 5 Series for DISS. Refer to schedule on drawings~~.

B. ~~Wall Outlets shall be DISS key style for Oxygen and Nitrous Oxide~~.

C. ~~Each outlet consists of a rough-in assembly and a finish assembly. The rough-in assembly consists of a zinc, die-cast backplate with mounting flanges on all four sides, a ½' raised plaster strike, and a non-removable, positive, pin keying arrangement for each specific gas service. Identification of each gas service is permanently cast into the plate. The rough-in inlet is a 7" long, ½" O.D., type K copper inlet tube, with a label identifying the specific gas by name and color, and a plastic dust cap. 360-degree rotation of the inlet tube allows alignment with system piping for connections~~.

D. ~~The outlet finish assembly of DISS type outlets consists of a powder-coated light neutral, zinc, die-cast, finish faceplate, a front-body keying disc assembly. The keying disc assembly includes a gas-specific, threaded, DISS-keying system that is color-coded and labeled with the name of the gas service. The serviceable barrel assembly includes a plastic piston and brass, primary, check valve that engage and seal when an equipment adapter is removed from the outlet~~.

E. ~~Finish Assembly faceplates shall be designed to provide 4.5" center to center spacing~~.

2.6 GAUGES AND SENSORS

A. All gauges, switches, sensors and demand checks manufactured by AMICO shall meet NFPA 99 2010 and be cleaned for oxygen in accordance with NFPA 99 2010 and shall be shipped to contractor in individual poly bags.

B. All gauges, switches and sensors shall be installed with individual shut-off ball valves and medical gas check valves between the device and the system. Alarm sensors installed remote from the piping may be installed with shut-off ball valves and medical gas check valves.

2.7 BUILDING AUTOMATION SYSTEM

A. The building automation system shall be furnished and installed under another section. This subcontractor shall provide dual contact pressure switches, tees, pipe wells, valves and caps to allow the connection from the BAS to the plumbing points required. The following table itemizes the equipment, location and type of device necessary to connect to the building automation system.

SERVICE OR EQUIP	PRESSURE	TEMP	FLOW	TROUBLE	CONTROL	LOCATION
Dental Vacuum Pumps Typical for (3) Pumps	X	X			Control Panel	Mech Rm Basement 002
~~Master Gas Alarm Panel~~				~~X~~	~~Alarm Panel~~	~~Corridor 230~~
~~Area Alarm Panel~~				~~X~~	~~Alarm Panel~~	~~Corridor 230~~
Air Compressor				X	Control Panel	Reciving Dock 138A
Dental Air Compressor Typical for (3) Compressors				X	Control Panel	Mech Rm Basement 002
Amalgam Seperation System				X	BAS	Mech Rm Basement 002

2.8 SEISMIC BRACING

A. The Plumbing Subcontractor shall provide all necessary design and materials for seismic restraint and protection of piping and devices against damage where subject to earthquakes as required for the entire medical gas and vacuum system within the building. All isolation and seismic devices shall be the product of a single manufacturer. Products of other manufacturers are acceptable provided their systems strictly comply with this section of the specifications. Provide isolation materials and seismic restraints complete and as manufactured by Mason Industries, Tolco or approved equal.

The work under this section shall include the design, furnishing and installation of all restraint devices and systems as may be required for the medical gas and vacuum system including, but not necessarily limited to, the following:

1. All Medical Gas/Dental equipment and devices such as pumps, vacuum, tanks, etc.
2. All Medical Gas system piping as required.
3. Piping penetrations through floors and walls.
4. Sleeves with clearances around the outside, as recommended.
5. Equipment isolation bases.
6. Piping flexible connectors.
7. Seismic restraints for isolated equipment.
8. Seismic restraints for non-isolated equipment.
9. Certification of seismic restraint designs.

B. Submit ten (10) copies of descriptive data for all products and materials, including the following:

1. Catalog cuts and data sheets for the specific isolators, restraints and all other items to be utilized.
2. Details of methods of sleeving, smokeproofing and isolation for pipes penetrating walls and slabs.
3. Specific details of seismic restraints and anchors, including number, size and locations for each piece of equipment.
4. Calculations to support seismic restraint designs.
5. All calculations, details and other submittal materials shall be sealed and signed by a structural or civil engineer registered in the state and qualified to perform seismic design calculations.
6. A seismic design liability insurance certificate that must accompany all submittals.

C. Code and standards requirements shall include, but not be limited to:

1. Applicable BOCA-NBC, MSBC with any additional State or Local requirements.
2. NFPA 99 2010 and other applicable NFPA standards.
3. All State and Local codes.

D. Manufacturers working in this section must provide a seismic design liability insurance certificate and certify their ability to provide engineering and design as required by this section. This certificate shall be submitted to the Architect for review prior to any submittals.

2.9 VIBRATION ISOLATION

A. General Requirements

1. The Plumbing Subcontractor shall provide noise and vibration isolation systems to prevent the transmission of excessive airborne and structureborne sound and feelable vibration to critical and non-critical areas of the building (medical gas equipment sound levels not to exceed NC-35 in critical and non-critical areas). Building vibration levels not to exceed recommendations of American National Standard S3.29 Guide for the Evaluation of Human Exposure to Vibration in Buildings.

2. Equipment vibration velocities in axial, horizontal and vertical directions not to exceed 0.20 inches per second in a one-third octave band centered at the shaft RPM. If bearings are not accessible, vibration limit applies at machine the mounting points.

3. All rotating equipment to be dynamically balanced by equipment manufacturers prior to arrival at the project site. Contractor shall, at no cost to the owner, balance equipment not conforming with rotational balance standard.

B. The work under this Section shall include the furnishing and installation of all equipment, appliances, materials, tools, labor and the performing of all operations necessary for the complete execution of the installation of noise and vibration isolation devices and/or systems as may be specified under the equipment specifications elsewhere contained in this Section, as may be scheduled on the drawings and as specified herein, including but not necessarily limited to the following:

1. All mechanical equipment such as pumps, air compressors, etc., shall be isolated from the building structure by means of noise and vibration isolators.

2. All piping over 1 inch diameter shall be isolated from the building structure by means of noise and vibration isolation hangers.

3. Piping penetrations through floors and walls shall not be rigidly connected to the building structure. Provide sleeves with clearances around the outside, as recommended by the vibration materials manufacturer. All such penetrations shall be smoke and firestopped in an approved manner as hereinbefore specified.
4. Generally, isolation facilities shall be designed to limit equipment room floor or roof loading to a maximum of 50 pounds per square foot and vibration isolators shall be carefully and specifically selected for each piece of equipment.

5. Motor driven equipment which is to be isolated, shall have motor mounted on the isolated equipment or shall have motor, equipment and drive mounted on a common base.

C. The vibration materials manufacturer shall be responsible for the proper selection of all isolation materials, including selection of spring rates to accomplish the specified minimum static deflections for spring and pad type isolators, based on weight distribution and location of equipment.

D. The Plumbing Subcontractor shall furnish to the vibration materials manufacturer the following:

1. A complete approved set of shop drawings of all isolated equipment showing operating weight and weight distribution at support points.

2. Submittal data shall be prepared by the vibration materials manufacturer and shall include drawings showing construction of the isolation devices to be used, including specific selection of isolators for each unit to be isolated and shall further include the complete design of supplementary bases, a tabulation of the design of each isolator showing spring O.D., free operating and solid heights, ratio of horizontal to vertical stiffnesses and other pertinent data as may be required to clearly indicate that the specified mount types and minimum static deflections are provided by the proposed systems submitted.

Installation shall not proceed until the submittal data has been reviewed and released for construction by the Architect.

E. Materials

1. The use of non-permanent materials such as cork, rubber, wood pulp products or thermal type fiberglass will not be acceptable.

2. The isolation materials, unless otherwise specified, shall be the standard products of Mason Industries, Vibration Eliminator Company, Consolidated Kinetics Corporation or Korfund Dynamics Corporation. Provide minimum 4" thick reinforced concrete pads beneath all floor mounted and vibration isolated equipment.

3. Vibration hangers for piping shall contain a steel spring and 0.3 inch deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid, equal to 50% of the rate deflection. Submittals shall include a scale drawing of the hanger showing the 30 degree capability. Hangers shall be Type 30N as manufactured by Mason Industries. Installed on piping in plumbing equipment room and within 50 feet of room.

F. Bolt Compressors and Vacuum Pumps to Inertia Bases

1. Be a steel reinforced concrete slab poured into a welded structural steel channel frame.
2. Be provided with height saving brackets that support base 1" to 2" above the floor or pad.
3. Be a minimum of 1/12th the longer base dimension, but not less than 6", or thickness such that the concrete inertia base weight is no less than the weight supported.
4. Have required mounting bolts to secure machinery supported as needed.
5. Mount inertia bases on sway-restrained steel spring isolators attached to inertia base by means of height-saving brackets. Springs to have minimum installed static deflection of 2".

G. For all pumps located in building, provide flexible stainless steel hose with stainless steel braid and carbon steel fittings at pump inlet and outlet. Sizes 2-1/2 inches and up shall be flanged. Pipe sizes up to 2 inches shall have male nipples. Lengths shall be as follows:

FLANGED		MALE NIPPLES	
2-1/2 x 14	8 x 22	1/2 x 9	1-1/4 x 12
3 x 14	10 x 26	3/4 x 10	1-1/2 x 13
4 x 15	12 x 28	1 x 11	2 x 14
5 x 19	14 x 30		
6 x 20	16 x 32		

H. All pump units less than 5 HP in the basement shall be installed and grouted in place in accordance with the

Standards of the Hydraulic Institute. All pump units less than 5 HP not located in the basement shall be mounted on height-restrained steel spring isolators sized to provide a 1" spade deflection. Attachment of isolators to the sides of pump base will be by height-saving brackets and as per manufacturer's recommendations. All pump units 5 HP and larger shall be grouted to concrete inertia bases in accordance with the standards of the Hydraulic Institute. Inertia bases shall be:

1. Be a steel reinforced concrete slab poured into a welded structural steel channel frame.
2. Be provided with height-saving brackets that support base 1" to 2" above the floor or pad.
3. Be a minimum of 1/12th the longer base dimension, but not less than 6", or thickness such that the concrete inertial base weight is no less than the weight supported.
4. Have required mounting bolts to secure machinery supported as needed.

I. Mount inertia block and pump assemblies on height restrained steel springs sized to provide a 1" spade deflection. Attachment of springs to inertia blocks shall be by means of height-saving brackets mounted to the sides of the inertia blocks. All springs to have minimum installed static deflection of 1".

1. After the installation of the pumps and piping has been fitted and adjusted, the pump manufacturer shall check the motors and pumps for proper alignment, shall check the pump glands for proper tightness and shall check all bearings for proper lubrication before the pumps are first started. When the pumps are started and placed in operation, the medical gas and vacuum subcontractor shall take complete amperage readings on each phase of all pump motors and nameplate current rating.

2. Mechanical vibration at the pump suction and/or discharge flanges shall not exceed 85 acceleration decibels over the frequency range of 20 Hz to 2.5 KHz. The critical frequencies of the fundamental rotational rate and vane shall not exceed 95 acceleration decibels referenced to 1 micro-g. The pump manufacturer shall be capable of furnishing certified sound test curves.

   a. Vibration Isolation

      1) Includes resilient mounts and hangers designed to minimize the transmission of vibration to the building structure. These are composed of steel springs, neoprene elements, or some combination of these.

   b. Equipment Bases

      1) Includes rails, inertia bases, or other steel carrying operating equipment.

   c. Flexible connectors to vibration isolated equipment

      1) Includes all hose, electrical, control, pipe, and duct connections to operating equipment mounted on vibration isolators.

   d. Vibration isolation performance criteria and testing.

      1) Includes procedures for ascertaining proper vibration isolation and operation. Refer to para. 1.06 Quality Assurance.

   e. American Society for Testing and Materials (ASTM)
      A-123 Zince (Hot Galvanized) Coatings on Products, etc.
      D-395 Compression Set of Vulcanize Rubber, Test for
      D-412 Tension Testing of Vulcanized Rubber
      D-573 Accelerated Aging of Vulcanized Rubber by the Oven Method, Test for
      D-624 Tear Resistance of Vulcanized Rubber, Test for
      D-797 Young's Modulus in Flexure, etc.
      D-1149 Accelerated Ozone Cracking of Vulcanized Rubber, Test for
      D-2240 Indentation Hardness of Rubber and Plastics by Means of a Durometer, Test for American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRA) Systems Manual (1989)
      American National Standards Institute (ANSI)
      S3.29 (1983) Guide to the Evaluation of Human Exposure to Vibration in Buildings

2.10 ELECTRICAL CONTROL AND INTERLOCKING WIRING

A. The electrical contractor shall furnish and install power wiring 208 volt, 120 volt connection only to all Medical/Dental equipment connected equipment and pumps including panels and motors. This subcontractor shall mount panels and shall furnish and install all control and interlocking wiring for each piece of medical gas and vacuum equipment including but not limited to remote alarms and local alarms for all medical gas equipment, medical gas alarms, pressure switches, flow switches and solenoid valves. All control wiring and interlocking wiring shall be installed in conduit and in accordance with the respective manufacturer's requirements and all connections shall be provided by the Plumbing Subcontractor. Wiring and conduit provided by this subcontractor shall be installed in accordance with the requirements of the Electrical SECTION 260000 of the specifications.

B. All electrical panels and life support panels shall be equipped with connection for emergency power hook-up, and/or the building automation system as required.

2.11 DENTAL VACUUM SYSTEM (ORAL EVACUATION)

A. GENERAL

1. The system shall be a central high volume type oral evacuation system for dental use, designed to remove liquids and debris generated during dental treatment procedures. The equipment and controls specified herein shall be as manufactured by The Spencer Turbine Company (800) 232-4321. The equipment and controls contained herein shall be installed as shown on the plumbing drawings.

B. SYSTEM COMPONENTS

1. The central high volume evacuation system will generally consist of the following:

a) Three (3) - Vacuum Producer Units (VP1, VP2 and VP3) & Electro-Mechanical
b) Recommended Spare Parts
c) One (1) - Central Liquid/Air Separator with Auto Discharge Pump Assembly
d) One - Anti-Surge Electronic Modulating Air-Bleed Assembly (EMDC)
e) One (1) - Master Control Panel
f) Piping System

C. DESIGN

The system shall be capable of supporting 100% of the 109 total point-of-use inlet ports (each port equivalent to a 9.0 mm or 0.34 open orifice). Each vacuum producer shall have a designed performance rating of 700 SCFM (1051 ICFM) at 10.0" Hg gauge vacuum as measured at the vacuum producer air inlet when handling air at 1.0 specific gravity, 36% relative humidity, 68º F, discharge pressure of 14.63 PSIA and shall be capable of serving 50% of the total demand.

The three (3) vacuum producers shall be connected in parallel, with each vacuum producer

capable of serving 50% of the total , thus assuring complete standby capability in the event (1) unit is out of service. The electronic and mechanical controls shall be designed to automatically alternate service of each vacuum producer.

D. DETAILED DESCRIPTION

1. VACUUM PRODUCER:

Each Multistage Centrifugal Vacuum Producer shall be a Spencer Turbine Power Mizer Model No. C523R56**.** Impellers shall be mounted on one shaft supported on each end by bearings mounted in the outboard bearing housings. The vacuum producers shall be built from parts cast in patterns from which previous units have been built and tested. Vacuum producers shall be of domestic origin and of manufacturer's standard design.

2. Casing

The casing shall consist of cast iron sections held securely between cast iron inlet and outlet heads with steel tie rods. The casing shall be constructed of high strength ASTM A48, Class 30 cast iron, suitably ribbed to withstand the stresses and strains of normal service at full operating pressure. The Inlet and Outlet connections shall be 8" diameter ANSI 125 lb. drilled and tapped flange pattern and shall be an integral part of the heads.

3. Impellers

The impellers shall be one-piece cast aluminum with the spacing hubs an integral part of the impeller casting. The impellers shall be keyed to the shaft with a one-piece key which extends the entire length of the impeller hub. Impellers shall be individually machine balanced, and shall be individually replaceable without requiring dynamic rebalancing of the entire rotating assembly to maintain factory vibration specifications. Vibration shall not exceed 1.25 mils in the vertical plane when measured at the vacuum producer bearing housing.

4. Diffusers

The diffuser sections, which receive air from the impeller and guide the air into the next impeller shall be provided with diffusing vanes and shall be an integral part of the section casting.

5. Shaft

The vacuum producer shaft shall be AISI 1045 steel or better, accurately machined and ground to size. The shaft shall be of ample size to carry the loads imposed under continuous service. Where the shaft passes through the

inlet and outlet head, seals shall be provided to prevent leakage. Seals shall be labyrinth type or carbon rings and shall be replaceable. Interstage shaft seals shall be provided to insure minimum leakage between stages.

6. Bearings

The vacuum producer shall be provided with oil-lubricated anti-friction bearings of ample size to carry the loads imposed under continuous service without overheating. Bearings shall be of sufficient size to have a minimum B-10 life in accordance with AFBMA standards of 75,000 hours under normal conditions of operation. Bearing housing shall be designed so that the complete rotating element can be lubricated, inspected or replaced without disconnecting any piping or disassembling the blower.

Lubrication shall be accomplished by means of constant level oilers on the bearing housing. For protection of bearings during shipment and installation, the bearings shall be properly processed with Esso Standard Oil Company “Rust Bane” or equal. Labyrinth type seals shall be provided between the bearings and the shaft seals to prevent lubricant leakage and to prevent the air from being contaminated by the lubricant.

7. Coupling

The vacuum producer shall be directly connected to the drive motor by means of a flexible gear type coupling rated for continuous service. The coupling shall be covered by an OSHA-Approved coupling guard.

8. Motor

Each motor shall be of the horizontal squirrel cage induction type and shall be built in accordance with latest NEMA, IEEE, ANSI and AFBMA standards where applicable. The motor rotation shall be coordinated with the vacuum producers specified above.

The motor shall have a premium efficiency rating, be suitable for operation at 208 volts, 3 phase, 60 Hz and shall have a 1.15 service factor with Class F insulation. Each motor shall be rated 40-HP at the full load speed of 3600 RPM and shall include an internal high motor temperature switch with leads contained in the exterior connection box. The motor enclosure shall be TEFC.

The motor frame and end shields shall be heavy fabricated steel or cast iron of such design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type of enclosure specified. Lifting lug “O” type bolts shall be supplied and the nameplates shall be stainless steel.

The shaft shall be made of high-grade machine steel or steel forging of size and design adequate to withstand the load stresses normally encountered in the motors of this particular rating.

Bearings shall be of the grease lubricated ball type with an AFBMA B-10 minimum life of 75,000 hours.

9. Baseplate and Mounting Pads

A common base plate fabricated from ASTM A36 structural steel shall be provided for the vacuum producer/motor assembly. The base plate shall be constructed to support the full weight of the vacuum producer, motor and accessories. Suitable resilient foundation mounting pads shall be provided.

E. VACUUM PRODUCER MECHANICAL ACCESSORIES:

1. Flexible Connectors

Equipment manufacturer shall furnish an 8" diameter full-flanged flexible expansion joint connector of shall be provided for each Vacuum Producer Inlet & Outlet. Flex Connectors are designed to alleviate stresses caused by thermal expansion and contraction in the piping system, and shall be capable of withstanding the pressure under all operating conditions and temperatures to 250°F. The expansion joint connectors shall be equipped with full-faced flanges, having ANSI 125 lb. drilling.

2. Throttling/Isolation Valves

Butterfly-type valves shall be provided for the inlet and outlet of each vacuum producer with adapter spools, if required. Valves and spools shall be of 8" diameter. The valve shall have a corrosion resistant shaft, steel or cast iron shutter, a resilient seat with cast iron lug body designed for air-tight service, hand-operated locking lever. They shall enable both throttling and positive isolation of the vacuum producer. Each valve shall be rated for a minimum of 15 PSIG and 250º F.

3. Check Valves

An 6" diameter full-flanged check valve shall be provided for each vacuum producer inlet. Each valve shall consist of a full-flanged body suitable for mounting between flanges, including aluminum discs, hinge post & clamp and flexible sealing member. The valve discs shall be designed such that when there is no flow, the discs shall be held tightly against the interior wall of the valve body, providing an airtight seal to prevent reverse flow.

4. Silencer

A discharge air noise silencer shall be provided for the discharge of each Vacuum Producer. The silencer shall be an absorptive type with double wall steel housing, acoustic packing and ANSI 125/150 drilled flanged ends of the same diameter as the vacuum producer discharge.

5. Acoustical Jacket

The Vacuum Producer exterior belly-casing shall be blanketed with a removable "tailor-fitted" Acoustical Jacket constructed of flexible sound abating material.

Vacuum Producer & Motor assembly as equipped shall have an estimated noise level of 89 dB(A) as measured at a distance of three (3) feet in a free-field environment.

6. Bearing Temperature Monitors

A Spencer Bearing Temperature Monitor shall be provided for each vacuum producer. The monitor shall shut down the vacuum producer in the event that either the inboard or outboard bearing should reach a temperature determined to be injurious to the bearing life span. During shut down a light on the master control panel shall indicate which bearing caused the shutdown. The control shall be such that the blower will not restart until the bearing has cooled, or has been replaced, and the reset button is activated. A heat sensitive 100 ohm platinum RTD shall be mounted on the inboard and outboard bearing housing of each vacuum producer with electronic controls contained in the Master Control Panel.

7. Vibration Monitor

A vibration transmitter with 4-20 mA output shall be mounted on inboard and outboard VP bearing housings to monitor the overall vibration level of each VP bearing housing with electronic controls contained in the Master Control Panel.

8. Surge Control

One (1) Electronic Modulating Air-Bleed Assembly (EMBC), common to all vacuum producers shall be provided. The EMBC shall include a motor-actuated full port ball valve, inline-mounting tee, air inlet noise silencer with rubber sleeve, safety screen, necessary components to join these components and electronic controls to be contained in the Master Control Panel.

F. CENTRAL AIR/LIQUID SEPARATOR:

1. The Central Air/Liquid Separator shall be a cylindrical shaped vessel capable of withstanding the maximum system vacuum. The separator shall be constructed of a non-metallic, inert, fiberglass reinforced plastic (FRP) with a premium grade vinyl ester resin bonded to the interior. The separator bottom shall be convex with a drain connection located at the apex. The Separator shall be supported by four bolted carbon steel legs with urethane top coat paint finish.

2. The vessel shall have a dished shaped bottom with a centered 4" flanged stub, flanged elbow, pipe extension with 1" male pipe stub, 4" hand operated discharge valve sandwiched between two flanges, terminating with 4" FPT, four welded legs with feet raising the vessel off the floor for ease of discharge pipe fitting connections. The separator shall be 42" diameter, have a maximum capacity (173) gallons and shall have a 12" diameter inspection port, 10" diameter flanged tangential inlet, 10" diameter flanged top axial outlet, wash down assembly with outside connection for provided solenoid valve and domestic water supply, liquid level sight glass with liquid sampling port, radial connection terminating to a funnel with a valve assembly for insertion of disinfectants to the vessel at shut-down, 3-probe-style level switch for high-level discharge pump activation, low-level pump shut-off and High Separator Level Alarm (three level probes shall be housed in a separate vessel having a field adjustable mounting bracket that will mate to receiving bracket on separator exterior), a mechanical ball float shut-off positioned at the air outlet, Inlet/outlet vacuum taps for "Separator Blockage Alarm" vacuum switches. Also included shall be a ¾-HP, 208 volt, 3-Phase, 60 Hz, 3500 RPM, TEFC motor driven pump rated for 60 GPM @ 10 ft. of head with necessary components including a check valve for automatic discharging of collected liquids upon high level collection. The pump assembly shall be field installed. A non-invasive totalizing flow-meter shall be supplied for field installation on pump discharge piping. The flowmeter shall provide visual indication of liquid volume discharge (gallons) and shall include a counter and 4-20 mA output for facility BMS.

G. VACUUM PIPING SYSTEM:

1. Piping

   The piping system shall be constructed of materials deemed appropriate by the piping manufacturer for the application and for the materials being handled. Sizing shall be in accordance with the plumbing drawings. See Vacuum piping specification 2.15 of this specification.

2. Fittings

   Fittings should be of long sweep design and of same material as the piping.

3. Joining Method

4. Piping joinery of fittings shall be as deemed appropriate by the piping/fittings manufacturer for the application and for materials being handled.

H. MASTER CONTROL PANEL:

1. Provide a Spencer NEMA-12 UL-Listed Control Panel for the automatic operation of three (3) Vacuum Producers (VP) and one (1) Central Air/Liquid Separator with accessories as equipped.

2. The control panel shall be manufactured by the vacuum equipment manufacturer and shall be built in accordance with UL508A Standards for Industrial Control Panels and shall include:

    1. One (1) - OSHA type lock-out/tag-out main disconnect circuit breaker
    2. Three (3) - ATL magnetic, non-reversing motor starters for three (3) 40-HP/208/3/60 Motors
    3. One (1) - ATL magnetic, non-reversing motor starter for one (1) ¾-HP/208/3/60 Motor
    4. Four (4) - Circuit Breakers (one for each VP and one for discharge pump motor)
    5. One (1) - Control transformer for 120 VAC/1/60 power supply for Local Panel
    6. One (1) - OFF / VP1 / VP2 / VP3 / AUTO - Selector Switch

        OFF - Off
        VP1 - Enables manual start/shutdown of Vacuum Producer (VP1) via local (control panel) start/stop push buttons
        VP2 - Enables manual start/shutdown of VP2 via local start/stop push buttons
        VP3 - Enables manual start/shutdown of VP33 via local start/stop push buttons
        AUTO - Enables automatic controlling of the all VPs based on the Auto-Mode Selector Switch (AMSS) setting.

        "Auto-Intermittent" Setting - The system will "start" and "shutdown" based on preset "start/shutdown" times/days of operation as set in the 24/7/365 field programmable clock controller (ie: System to run Monday through Friday, from 7:00 A.M. to 5:00 P.M.). Alternation of VPs shall occur upon each start/shutdown sequence. Should System be in OFF TIME, controls shall provide for Remote Start/Stop capability of the system via one (1) Remote Start/Stop Station located in Urgent Car Level 2.

        "Auto-Continuous" Setting - The system shall run continuously (24/7) without interruption.

Alternation of the VP's shall occur at a preset time/day in the local "Alternation Clock-Controller" (ie: VP alternation to occur every Monday at 7:00 A.M.). When VP alternation occurs in the in the "24/7" setting, the sequential stand-by VP shall start and the previously on-line VP shall have a delayed shutdown to allow the new on-line VP time come up to speed, thus providing the required vacuum and flow to insure uninterrupted service.

In either Auto-Mode Setting, a stand-by VP shall start when the maximum capacity of the on-line VP is reached, thus enabling both VPs to share the increased load. The sequential VP will shut down after a minimum "run time' when the additional capacity is no longer required. This insures that the increased demand shall be met up to 100% of designed demand.

7. One (1) - Set of Start/Stop/Reset push buttons
8. One (1) - Auto alternator control to alternate VPs based on auto-mode setting
9. One (1) - 24/7 Programmable Clock-Controller for VP alternation during auto-continuous operation
10. Three (3) - 24/7/365 Programmable Clock/Controllers, for Auto Intermittent Operation Dates/Time, one to alternate VPs during Auto Continuous Operation and one to control Separator overhead wash down cycling
11. One (1) - "Helper-Starter Controller" designed to start a stand-by VP when maximum capacity of on-line booster is reached and shutdown the sequential VP when added capacity is no longer required
12. One (1) - Visual Setpoint Electronic Modulating Air Bleed Controller, with visual display of current draw in amperes, calibrated flow in SCFM of each on-line VP motor and provision for manual control of the EMBC Valves for start-up and test procedures
13. Three (3) - Calibrated Ammeters (visual display of each VP motor current and calibrated volume in SCFM)
14. Provisions for Remote Start/Stop capability of the system via one (1) Remote Start/Stop Station located in Urgent Care level 2.
15. One (1) - H-O-A Selector Switch for Separator discharge pump

H - Hold to RUN Pump/Spring Return to STOP
O - OFF
A - Automatic Pump Operation – Pump will activate via HIGH LEVEL probe/switch mounted on Separator. Pump will then RUN at field selectable ON/OFF TIME durations (adjustable via Panel OIT) until Separator reaches low level probes. Minimum OFF TIME intervals (ie: 20 minutes) must be maintained to prevent short-cycling of pump motor. This will enable smaller volume batches of effluent feed to downstream AMALGAM Separator.

16. Provisions to start/stop the Central Air-Liquid Separator discharge pump per high/low level signaling from level control when Separator H-O-A Switch is in the AUTO position
17. One (1) - Level Controller to monitor liquid level in separator, start stop pump and energize warning light and horn for pump failure.
18. Provision to start/stop separator wash down at preset time intervals
19. One (1) - H-O-A Selector Switch for Separator Overhead Auto-Washdown (enables manual controlling)
    H - Activates overhead washdown system
    O - OFF
    A - Enables AUTO controlling of washdown cycling
20. Provisions to energize a warning light and sound local alarm in the event of "High Liquid Level" in Central Air/Liquid Separator.
21. Provision to immediately start a stand-by VP, energize a corresponding VP "Start Fault" warning light and sound local alarm if the targeted VP fails to start upon a "Start Command"
22. Provision (current sensor) to trigger immediate start of a stand-by VP, energize a corresponding "VP Motor Failure" warning light and sound local alarm upon any VP motor failure
23. Provisions to trigger immediate start of a stand-by VP, energize a corresponding "VP / High Inboard or Outboard Bearing Temperature" warning light and sound local alarm upon detection of any high VP bearing temperature
24. Provisions to trigger immediate start of a stand-by VP, energize a corresponding "VP / High Inboard or Outboard Bearing Vibration" warning light and sound local alarm upon detection of any high VP bearing vibration
25. Six (6) Setpoint controllers to accept (6) inboard and outboard bearing RTD's to energize warning light, alarm horn and shutdown the vacuum producer on "High Inboard Bearing Temp" and "High Outboard Bearing Temp" two per machine.
26. Six (6) Setpoint controllers to accept (6) inboard and outboard bearing Vibration Transmitters to energize warning light, alarm horn and shutdown the vacuum producer on "High Inboard Bearing Vibration" and "High Outboard Bearing Vibration" two per machine.
27. Panel Display lights for:
    - Power "ON"
    - VP1/VP2/VP3 - "RUNNING"
    - VP1/VP2/VP3 - Start Fault
    - VP1/VP2/VP3 - Motor Failure
    - VP1/VP2/VP3 - High VP Inboard Bearing Temperature
    - VP1/VP2/VP3 - High VP Outboard Bearing Temperature
    - VP1/VP2/VP3 - High VP Inboard Bearing Vibration
    - VP1/VP2/VP3 - High VP Outboard Bearing Vibration
    - VP1/VP2/VP3 - High Motor Temperature
    - High Liquid Level in Separator

- Separator Discharge Pump "ON"

28. One (1) - Lamp Test push button to energize all pilot lights for a lamp test
29. Provide dry output contacts (field selectable NO/NC) for Common Local Alarm to (Facility BMS)
30. One (1) - Alarm horn, mounted in panel door with reset and silence push buttons
31. Provisions for three (3) elapsed "run time" hour meters
32. Three (3) - Elapsed "run time" hour meters
33. Miscellaneous components and hardware to assure proper functioning

I. OPERATION AND MAINTENANCE MANUALS

1. Prior to delivery of equipment the manufacturer shall furnish handling, installing and operating instruction manuals that shall include the following information:

   - Guide to "trouble shooting"
   - Assembly, installation, and alignment instructions.
   - Operating instructions.
   - Maintenance instructions including schedules of routine maintenance and lubrication checks.

J. SPARE PARTS

1. The following spare parts shall be provided:

   - One (1) set Blower Bearings
   - One (1) set Blower Gaskets
   - One (1) ea. Shaft Coupling

K. SURFACE PREPARATION AND SHOP PAINTING

1. Surface preparation and shop priming shall be manufacturer's standard.

L. FACTORY TESTING

1. Each vacuum producer shall be given a factory test to assure mechanical integrity. In addition each vacuum producer will be subjected to a performance test which shall monitor the vacuum developed and power consumption as a function of the flow rate. A certified performance curve of the actual test data shall be made available. In addition, a vibration check shall be made to ensure the vibration amplitude shall not exceed 1.25 mils. If either test indicates hat adjustments are necessary to insure conformance to the manufacturer's standards, such adjustments shall be made prior to shipment.

M. START-UP

1. Contractor shall provide start-up service of the system by manufacturer's factory service technicians and factory-trained manufacturer's representative. Start-up service shall include inspection of overall installation, laser alignment of all Vacuum Producer mechanical couplings, setting & adjustment of all controls, initial start-up and running of the system, confirmation of all automated and alarm functions, vacuum test, and operational and maintenance instruction of owner's designated personnel.

N. WARRANTY:

1. Manufacturer shall warranty to replace or properly repair equipment and materials in which defects develop within a period of or eighteen (18) months from the date of shipment or twelve (12) months from date of start- up, whichever occurs first.

2.12 DENTAL AIR SYSTEM

A. Quantity of three (3) as supplied by Air Energy, Inc, Easton, MA (1-800-696-4425).

1. SPECIFICATION SCOPE

1.1 This specification covers the requirement for supply of a packaged oil-free rotary air cooled screw air compressor, Kobelco KNW Series model KNWA0 D/H . Each compressor to be (60) HP, oil free, two stage, air cooled.

1.2 Any and all exceptions to the specification shall be clearly identified in the proposal under a section entitled, "Exceptions to Specifications."

2. GENERAL REQUIREMENTS

2.1 The manufacturer shall supply a positive displacement, two-stage rotary screw air compressor capable of delivering 100% oil-free air. There shall be no lubricants in the compression chamber. The assembly shall be fully packaged, including air compressor, main drive motor, oil cooler, intercooler and aftercooler, separate motor driven lubrication system, regulation and control systems, all mounted on a common base frame and fully enclosed by a steel sound dampening enclosure.

2.2 The compressor shall be the manufacturer's standard oil-free, two-stage rotary screw air compressor package. The compressor shall consist of two compressor stages connected to an integral speed increaser. Each stage is to be driven from a common bull gear to ensure optimum speed and high efficiency. There shall be an air-cooled intercooler between the first and second compression stages and an air-cooled aftercooler installed after the final stage.

2.3 The capacity shall be expressed in terms of free-air delivery in actual cubic feet per minute (ACFM) measured at the discharge pressure and related back to inlet conditions. The capacity and shaft power shall be guaranteed per modified ASME PTC9. The ACFM and shaft power

quoted shall be within the following tolerances:

Air Delivery ..... ± 4%

Power Consumption ..... ± 5%

Each compressor shall be rated at 223 ACFM at 100 PSIG discharge pressure and be suitable for use on 280 volt, 3 phase, 60 Hz. Unit MUST BE capable of maximum pressure operation of 150 PSIG. Each compressor shall be equipped with a solid state reduced voltage starter suitable for 208 volt 3 phase operation.

3. COMPRESSOR UNIT

3.1 Casing

The compressor air-end shall be a class 35 cast iron housing with precision manufactured, helical screw type rotors. The housing shall be air-cooled.

3.2 Rotors

Rotors and shafts shall be one-piece SUS420 stainless steel construction. Internal rotor cooling shall not be required. Rotors shall have an asymmetric profile to ensure high efficiency. Rotors shall be coated with M_0S_2 for sealing clearances. Rotors shall be dynamically balanced to guarantee vibration-free operation. Rotary lobe type compressors shall not be acceptable.

3.3 Timing Gears

Precision timing gears shall be manufactured of chromium molybdenum steel and be fitted to the rotor shafts and shall maintain precise rotor-to-rotor clearance. Gears shall be designed to assist in thrust canceling and absorb no more than 10% of input power under full load.

3.4 Bearings

Anti-friction bearings shall be incorporated on each rotor. Radial loads shall be carried by straight roller bearings. Axial loads shall be carried by two sets of angular contact ball bearings.

3.5 Speed Increaser

A speed increaser shall be an integral part of the compressor unit and include the main drive shaft bull gear. The gear train shall be so designed to be thrust canceling.

3.6 Seals

The seals shall be restrictive ring type, self-adjusting and centering and constructed of stainless steel. The oil and air seal chambers shall be vented to atmosphere to prevent any possible contamination of the compressed air stream. Carbon seals shall not be acceptable.

3.7 Gaskets

All gaskets shall be asbestos free.

3.8 Coolers

The compressor cooling system shall be comprised of a separate motor driven fan and incorporate the following coolers:

3.8.1 Air-cooled oil cooler.

3.8.2 Air-cooled intercooler complete with moisture separator and automatic drain.

3.8.3 Air-cooled aftercooler complete with moisture separator and automatic drain.

3.8.4 The cooling fan shall be driven by a separate motor, starting and stopping with the oil pump for maximum cooling during start-up and shutdown.

3.8.5 All coolers shall be cross-flow aluminum construction to achieve maximum cooling efficiency and shall be rated for 150 PSIG at 500 degrees F. operating conditions.

3.9 Drive Motors

The main drive motor shall be horizontal ball bearing, NEMA design B with class B temperature rise and class F insulation and energy efficient TEFC.

3.9.1 The oil pump motor shall be (TEFC) C flange connected through a non-lubricated coupling for permanent shaft alignment.

3.9.2 The cooling fan motor shall be totally enclosed fan-cooled (TEFC) for maximum service life.

3.10 Lubricating System

3.10.1 Lubrication oil for the compressor shall be contained in an integral sump.

3.10.2 A separate direct driven gear type oil pump shall be provided to ensure positive lubrication at start-up when gear and bearing loads are at their peak.

3.10.3 The drive gear, all bearings and timing gears in each stage shall be spray lubricated.

3.10.4 All bearings and timing gears shall be pre-lubricated prior to start-up and continue to be lubricated during shutdown. This time period for lubrication shall be monitored and controlled by the unit's internal control system.

3.11 Pressure Regulating System

The regulating system shall be a full load/no load type for maximum efficiency.

3.12 Control System

3.12.1 The control system shall be integral with the compressor package and shall consist of an electro-pneumatic regulator, designed to provide manual and automatic running. The capacity control valve shall be a disc type for trouble-free operation.

The control system voltage shall be 115 volts, 60 Hz. The control system shall provide automatic shutdown of the compressor during periods of excessive idling.

3.12.2 The control system shall be controlled and monitored by a Allen Bradley Programmable Logic Controller (PLC). This controller will initiate and sequence the events during start-up, operation, and shutdown. The PLC will monitor system functions, safety devices, and instrumentation. The PLC will incorporate an Erasable Re-programmable Read Only Memory (EPROM) for permanent program storage. This device shall enable control sequences to be changed on site or in the manufacturer's factory to meet future plant needs. The control system shall provide for the following:

a. Start oil pump to ensure positive lubrication prior to start-up of the main drive motor.

b. Start cooling fan when oil pressure is established.

c. The compressor shall start unloaded and shall shut down unloaded, ensuring maximum component life.

d. The oil pump shall continue to run until the compressor stops.

e. Stop cooling fan motors 20 seconds after compressor is stopped to exhaust latent heat.

f. Dry contacts are provided for remote indication of power failure or fault conditions and run indication.

g. The control system shall provide automatic shut-off of the compressor if it remains unloaded for 10 minutes (to conserve energy) and shall automatically restart compressor on demand.

h. Service indication shall be provided when it is time to perform routine maintenance.

i. Shutdown indication shall occur with "first out" (first failure) feature when abnormal operating parameters are reached. Pre alarms shall be required for all temperature shutdowns.

j. Shall be adaptable to accept optional automatic or manual lead/lag control, sequencer control, automatic restart following power failure, remote start/stop control, or other controls as may be required for future plant needs.

k. Shall be expandable to automatically start dryers, pumps, cooling tower, or other remote devices.

l. Shall be capable of recording time and day of last 100 alarms/events.

3.13 Monitoring Equipment / Operater Interface

3.13.1 Operator interface shall be touch screen type with graphics, sunlight readable, 16 shades of gray or color to read compressor data easily. Three configurable graphs for historical trending shall be standard.

3.13.2 Minimum required devices:

a. First-stage discharge air pressure display.

b. Second-stage discharge air pressure display.

c. Oil pressure display.

d. Air inlet filter service indicator.

e. Digital first-stage discharge air temperature display.

f. Digital second-stage air inlet temperature display.

g. Digital second-stage discharge temperature display.

h. Digital aftercooler outlet air temperature display.

i. Digital oil temperature display.

j. Low oil pressure indicator.

k. Running time display.

l. Loaded time display.

m. Standby light.

n. Power-on light.

o. Motor overload indication.

p. Compressor run light.

q. Oil pump run light.

r. Fan run light.

s. Load light.

t. Manual unload button.

u. Oil level gauge.

v. Oil filter condition indicator.

w. Alarm buzzer.

x. Lamp test switch.

y. Buzzer cancel switch.

3.14 Safety Devices

Compressor shall have automatic shut-off devices for the following conditions:

3.14.1 Low oil pressure.

3.14.2 High outlet air pressure.

3.14.3 High first-stage discharge air temperature.

3.14.4 High second-stage inlet air temperature.

3.14.5 High second-stage discharge air temperature.

3.14.6 High outlet air temperature.

3.14.7 High oil temperature.

3.14.8 Compressor motor overload.

3.14.9 Lube oil pump motor overload.

3.14.10 Cooling fan motor overload.

3.14.11 High cabinet temperature.

3.14.12 Main starter failure.

The unit shall automatically stop, annunciate by alarm bell, and indicate the appropriate failure by alarm and text display. Alarm bell must remain on until manually reset.

3.15 Filter System

3.15.1 Air intake filters are to be enclosed in package and easily accessible for service. Air entering the compressor shall be drawn from outside the package with a remote air intake adaptor externally mounted on each cabinet.

3.15.2 Filters shall be paper cartridge type.

5 micron - 99% or greater efficiency.

3.16 Compressor Enclosure

3.16.1 The compressor unit, including motor, shall be enclosed in a steel sound insulating canopy with doors to provide ready access for normal maintenance.

3.16.2 The doors shall be removable. Enclosure and base frame to be painted for long life and durable finish.

3.16.3 Sound insulating material shall be nominal 2 pounds per cubic foot polyether foam with UL94HP-1 flame resistance. Sound insulating material shall be 1 inch thick.

3.16.4 Enclosure shall be ventilated using a separate motor driven fan starting when oil pressure is established and stopping 20 seconds after the compressor stops.

3.17 Noise Levels

The compressor package noise level shall not exceed 74 dBA at three (3) feet.

B. Additional EQUIPMENT

The following optional equipment could be included in the assembly provided. Check options required.

4.1 Lead/lag control for _3_ -machine operation. (Indicate: automatic.) The master control shall be integrated with air compressors. Separate wall mounted controllers will not be acceptable.

4.2 Auto restart after power failure.

4.3 Each compressor is supplied with the Health Care Facilities Package which includes the lead/lag, lag in use alarm, non fused disconnect each unit, auto restart after power failure and remote air intake to meet NFPA-99 medical compressed air code requirements.

4.4 Each compressor will interface with the owner supplied Building Control Monitoring system to be determined.

4.5 Each compressor to accept remote start/stop signal.

4.6 Compressors will be required to be programmable for user defined operating times.

C. Air Treatment

1. Supply two (2) Parker domnick hunter model DRD-500 cycling refrigerated air dryers each with a capacity of 500 SCFM at 100 degree F inlet temp, 100 PSIG, 100 degree F ambient. Each dryer will be manufactured with a thermal mass device designed to allow for refrigerant compressor cycling to reduce power consumption during reduced load periods. The compressor shall be a rotary scroll style compressor using R407C refrigerant to further reduce power consumption. Package kW shall not exceed 3.23 with a power input of 208 volt three phase. The dryer will be factory filled with coolant and tested prior to shipment. The scroll compressor will be variable speed controlled to match compressor power to actual operating load. Each dryer is equipped with a zero air loss automatic condensate drain to prevent unnecessary loss of compressed air during condensate purge stages. The compressor shall have a pressure dewpoint of 37 degrees F at 100 PSIG. The microprocessor shall control compressor operation as well as monitor all operating systems with a digital multi function display. The display shall include dewpoint, alarms, status report and maintenance cycles. Each dryer is equipped with dry contacts for remote alarming. Each dryer is equipped with a domnick hunter OilX coalescing filter rated for .01 micron. The filter shall be shipped loose for field mounting on the discharge side of the dryer. The dryer will include an automatic float type drain and a filter condition monitor.

   One (1) Dew point monitor, shipped loose. GFG ABL 4021 or equal. The dew point monitor will be equipped with an audible and visual alarm, LCD display and dry alarm contacts.

D. Air Receivers.

1. The compressed air side of the system shall be equipped with two (2) ASME air receivers, the primary receiver will be considered the “wet tank” and be field installed before the dryers or air treatment. The second tank shall be considered the “dry tank” and be placed post air treatment. Each tank will be 240 gallon capacity, 200 PSIG working pressure, ASME code, National board listed. The primary tank will be fitted with a safety valve, pressure gauge (0-300 PSIG), and automatic “no air waste” condensate drain. Each tank will be epoxy lined for corrosion resistance.

2.13 COMPRESSED AIR SYSTEM

A. Triplex SCROLL AIR COMPRESSOR

Furnish and install, where shown on the drawings a tank mounted prefabricated oil less compressed air system model no. STT-0504-X-2-AESPL as supplied by Air Energy – South Easton, MA (508-230-9445).

B. GENERAL
The Powerex oil-less tank mounted scroll system is designed to provide clean, dry air for applications where the quality of compressed air is critical.

C. SCROLL AIR COMPRESSOR SYSTEM
The package shall include three oil-less scroll type air compressors and associated equipment, one ASME air receiver, one deluxe magnetic starter/alternating control panel. The only field connections required will be system discharge, power connection at the control panel and dryer, and condensate drain connection. All interconnecting piping and wiring shall be included and operationally tested prior to shipment. Vibration isolation pads are included with the system.

D. OILLESS SCROLL COMPRESSOR PUMP
The compressors shall be belt driven oil less rotary scroll single stage, air-cooled oil less construction with absolutely no oil needed for operation. The rotary design shall not require any inlet or exhaust valves and shall be rated for 100% continuous duty. Direct drive compressors shall not be used. Tip seals shall be of a composite PTFE material and be rated for 10,000 hours operation. Compressor bearings shall be external to the air compression chamber and shall all be serviceable for extended compressor life. Bearing maintenance shall not be required until 10,000 run hours. Compressors with bearings that are not accessible for service have a limited life span and shall not be accepted. Compressors shall have an integral radial flow fan for cooling and shall not require any additional electric cooling fans. Each compressor shall include a discharge check valve, an isolation valve, an air-cooled after cooler, a moisture separator with automatic drain and a flexible connector.
Each compressor pump shall deliver 15.2 cfm @ 100 psi, for a total system delivery of 45.6 cfm @ 100 psi. Noise level shall not exceed 72 dba.

E. MOTORS
Each compressor shall be belt driven by a 5 HP, 3 phase, 60 cycle, 208 volt, 1750 RPM, TEFC NEMA construction motor. Motors operating at speeds higher than 1750 RPM shall not be acceptable. OSHA approved belt guards shall be provided. Motor shall not operate in the service factor.

F. AIR RECEIVER
The system shall include an 120 gallon, epoxy lined, ASME rated air receiver, rated for 200 PSI MAWP. The tank shall be equipped with a pressure gauge, safety relief valve, discharge shut-off valve, and 115V automatic solenoid timer drain with manual over-ride. The air receiver shall include an internal epoxy lining for corrosion resistance.

G. CONTROL PANEL
The system shall include a UL listed control panel in a NEMA 12 enclosure with alternating relay and pump selector switch. The following accessories are included for each pump:

Circuit breaker disconnect, magnetic starter with 3-leg overload protection, run lite, hour meter and overload reset button. Compressor operation is start / stop, with each compressor alternating lead and lag positions. All compressors will operate simultaneously if system demand requires.

H. REFRIGERATED AIR DRYER - Deltech SPX Model No. HG50
The separately mounted refrigerated air dryer provides air at a 38 degree F pressure dewpoint. The refrigerated air dryer is of the non-cycling type, direct expansion, using R-134a refrigerant (CFC free). A hot gas bypass valve is provided to maintain a 38 degree F evaporator temperature. The dryer is self-regulating for large load swings, and includes a 3 micron filter/separator with automatic condensate drain, on/off switch, power on lite, and a dewpoint temperature indicator. A .01 micron coalescing after filter and a pressure regulating valve shall be provided. The dryer capacity will not be less than 50 SCFM.

I. Air Filtration: One (1) factory piped coalescing filter rated for 0.01 micron. The filter will be supplied with a float type drain.

J. WARRANTY
The warranty on the air ends will be three years from date of shipment, and one year from the date of shipment on the overall system.

2.14 DENTAL VACUUM PIPING SYSTEM

A. Dental Vacuum Pipe and Fittings (Under Slab)

1. Polyproplyene Pipe Schedule 40 joined by the coil fusion method. Pipe shall be manufactured of non-flame retardant homopolymer polypropylene (in buried applications where long piping runs may be effected by live loads above, Schedule 80 non-flame retardant copolymer pipe shall be used).
2. Polypropylene fittings shall be manufactured to Schedule 40 dimensions. Fittings shall be joined to the polypropylene pipe by means of coil fusion method**.**
3. All components of the system shall conform to the following applicable ASTM Standards, D4101, D3311, D1599, D2122, F1290 and F1412. All pipe shall be marked with manufacturers name, pipe size, schedule, type, quality control mark and ASTM information. All fittings shall be legibly marked showing manufacturer's trademark, fitting size, manufacturers part number, and symbol indicating the material.
4. Shall be Fuseal pipe and fittings as manufactured by GF Piping Systems LLC.
5. All change in direction fittings shall be long sweep type.

B. Dental vacuum Pipe Fittings (above Slab only in Mechanical room and shaft)

1. Polyproplyene Pipe Schedule 40 joined by the coil fusion method. Pipe shall be manufactured of flame retardant homopolymer polypropylene. Flammability requirements are based on ASTM D635 "Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self Supporting Plastics in a Horizontal Position.
2. Flame Retardant Polypropylene fittings shall be manufactured to Schedule 40 dimensions. Fittings shall be joined to the polypropylene pipe by means of coil fusion method. Fittings shall meet the same flammability requirements as described for pipe above.

3. All components of the system shall conform to the following applicable ASTM Standards, D4101, D3311, D1599, D2122, F1290 and F1412. All pipe shall be marked with manufacturers name, pipe size, schedule, type, quality control mark and ASTM information. All fittings shall be legibly marked showing manufacturers trademark, fitting size, manufacturers part number, and symbol indicating the material**.**
4. Shall be Fuseal pipe and fittings as manufactured by GF Piping Systems LLC.
5. All change in direction fittings shall be long sweep type.

C. Dental Vacuum Pipe and Fittings above grade (Plenum ceilings)

1. Polyvinylidene (PVDF) Pipe Schedule 40 joined by the coil Fusion method. Pipe shall be manufactured of flame retardant PVDF for service in plenum rated areas or high temperature (to 280 degrees) flow stream. Flammability requirements are based on ASTM D635 “Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self Supporting Plastics in a Horizontal Position”. The pipe must also meet or exceed ASTM E84 25/50 (UL 723) and UL 94-VO.
2. Flame Retardant Polyvinylidene (PVDF) fittings shall be manufactured to Schedule 40 dimensions. Fittings shall be joined to the PVDF pipe by means of coil fusion method. Fittings shall meet the same flammability requirements as described for pipe above**.**
3. All components of the system shall conform to the following applicable standards, ASTM E-84 25/50 (UL 723) andUL 94-VO.All pipe shall be marked with manufacturers name, schedule, pipe size, ASTM-F1673, E-84, UPC, UL Classified date stamp and “Made In USA”.All fittings shall be legibly marked showing manufacturers trademark, fitting size, manufacturers part number, symbol indicating the material, ASTM F1673, UPC, USA.
4. Shall be Fuseal 25/50 pipe and fittings as manufactured byGF Piping Systems LLC
5. All change in direction fittings shall be long type..

D. Dental Vacuum Pipe and Fittings above slab (under bench)

1. Polyproplyene Pipe Schedule 40 joined by the mechanical joint method. Pipe shall be manufactured of flame retardant homopolymer polypropylene. Flammability requirements are based on ASTM D635 “Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self Supporting Plastics in a Horizontal Position**.**
2. Flame Retardant Polypropylene fittings shall be manufactured to Schedule 40 dimensions. Fittings shall be joined to the polypropylene pipe by means of mechanical joint connection. Fittings shall meet the same flammability requirements as described for pipe above.
3. All components of the system shall conform to the following applicable ASTM Standards, D4101, D3311, D1599, D2122, F1290 and F1412. All pipe shall be marked with manufacturers name, pipe size, schedule, type, quality control mark and ASTM information. All fittings shall be legibly marked showing manufacturers trademark, fitting size, manufacturers part number, and symbol indicating the material.
4. Shall be Fuseal MJ fittings as manufactured by GF Piping Systems LLC.
5. All change in direction fittings shall be long sweep type.

E. Installation

1. Pipe and fittings shall be installed according to current installation instructions as delivered in print or documented online at www.gfpiping.com . An on site installation seminar shall be conducted by GF personnel who are certified to conduct said seminar. Seminar topics shall include all aspects of product installation (storage, set up, support spacing, fusion process, mechanical joint process, testing procedure, etc.). At the conclusion of the installation seminar, all installers will be given a certification test and, upon successful completion of said test, will be issued a certification card verifying that they have met the requirements of the manufacturer with regards to knowledge of proper product installation and testing methods.
2. Only the GF Piping Systems LLC fusion units MSA-250 SE or "Electro Plus"may be used in the installation of the Fuseal and Fuseal 25/50 pipingsystems. Under this specification, the contractor shall be responsible for purchasing either one MSA-250 SE or one "Electro Plus" fusion unit for use in installation of the product on site. At the completion of the installation and testing of the piping system, the contractor shall turn over the fusion unit to facility personnel for their use in future system upgrades, layout changes, etc.
3. Installer shall ensure that all pipe and fittings used for the acid resistant pipe system are components of the same system. No mixing of various manufacturers pipe and or fittings shall be allowed. Acceptable manufacturers are GF Piping Systems LLC.

F. Testing

1. The system shall be tested in accordance with all local plumbing codes. All sections of the piping system shall be tested with a maximum of 30 foot head of water (approx. 15 PSI) for fusion system. Under no circumstances should the system be tested with air or any other gas. Joints may be pressure tested 10 minutes after fusion is completed. (Mechanical joints shall be tested to a minimum 10 foot head or 5 PSI).

G. Valves

1. Valves shall be as mfg by gf piping systems. Valves shall be comparable with piping material and system being used for dental vacuum system. Valves shall be ball valve type up to 4". 6" and above shall be butterfly type.

2.15 AMALGAM SEPERATOR SYSTEM

A. Plumbing contractor shall provide in conjunction with Rebel solutions (1-800-569-1088) A complete amalgam separator system to work in conjunction with the proposed dental vacuum system and that meets all requirements of the University of New England and the State of Maine DEP regulations. Plumbing contractor will be required to provide all required material, equipment, testing, start up and supervision as necessary to support this system. Plumbing contractor shall be responsiable to submit all required information to the local and state authorities for approval and installation. Contractor shall pay all required coast.

B. Main system tank:
   1. 300 Gallon cone bottom poly tank on stand. The fittings exiting the bottom of the tank will be supplied by Rebec.

C. Buffers:
   1. This system is equipped with 8 / 7001 pre-filter buffers. These buffers are used to collect the larger particles such as tooth particles and larger pieces of amalgam. These buffers also extend the life of the collectors by adding to the volume capacity of the system.

D. Collectors
   1. This system is equipped with 8 – ISO11142-2008 approved collectors. These collectors are rated to remove 99.8% of the effluent from the waste stream This system will consist of: Rebec REB300-CB 300 gallon poly tank System stand Custom integrated stand used to ad height to aid in proper flow 3001 Collectors ISO11143-2008 approved collectors 7001 Buffers Pre-filters Plumbing Package of plumbing for setup

E. Testing Protocols
   1. Testing of your amalgam separator must be done in accordance with the**.**state of Maine DEP.

F. Maintenance
   1. Flushing of the system required in maintaining system.
   2. Running enzyme based line cleaner through the system on a regular basis will aid in preventing the buildup of bacteria in the lines.
   3. Changing of the buffers and collectors after the first year and changing them in accordance with the recommendation of Rebec Solutions.

PART 3 - INSTALLATION

3.1 VALVE TAGS AND CHARTS

A. All valves on pipes of every description shall have neat circular brass vale tags of at least 2" in diameter, attached with brass hooks to each valve stem. The vale number shall be stamped on the brass tag. The numbers shall be consecutive. In addition, each valve shall have a properly completed cardboard valve tag which shall note Tag #, Valve #, System, Control Area, Building and Special Instructions. Tag to be Brady or Approved Equal. Tags and chains shall be extended from valve to just above ceiling tile.

B. Tag numbers shall correspond to numbers indicated for valves on the record drawings and on three printed detailed lists. These printed lists shall state the number and location of each valve and the area which it controls and other necessary information, such as requiring the opening or closing of another valve or valves, when any one valve is to be opened or closed.

C. Printed detailed lists shall be presented to and approved by Engineer before the space is occupied. This list shall be submitted in electronic file format as approved by Engineer.

3.2 IDENTIFICATION

A. All labeling of piping, materials, and equipment, as outlined hereinafter for identification purposes, shall be performed by this Subcontractor.

B. The pipe markers shall be installed on the apparatus in full view and shall be a color that is in sharp contrast with the background. Color coding to be in accordance with the standards outlined in the American Hospital Association latest publication.

C. Before markers are applied, the apparatus shall be thoroughly cleaned and painted, if necessary.

D. Letters shall not be less than 1-1/2" in height. Arrows shall not be less than 9" long.

E. All ~~medical gas~~ and dental piping systems exposed, above removable ceilings, and above furred spaces, shall be identified at intervals of approximately 20', at each change of direction and on both sides of walls for pipes passing through walls.

F. Piping systems shall be identified with approved snap-on covers designating services and direction of flow. Location of identification covers shall be near access panels wherever possible on both sides of valves. The markers shall be as manufactured by W.H. Brady Company, Westline Products, Seton Nameplate Company or approved equal.

G. The following Engineering Standard is based on NFPA 99-2010 and piping shall be marked as noted.

SYSTEM	BACKGROUND	LETTER
~~Oxygen~~	~~Green~~	~~White~~
Dental Vacuum	White/Strip	Black
~~Dental Air~~	~~Yellow/Stripe~~	~~Black~~
~~Nitrous Oxide~~	~~Blue~~	~~White~~

Compressed Air	Yellow/Check Board	Black

3.3 CORE DRILLING

A. All core drilling required for the installation of the Medical Gas & Dental systems is to be done by this Plumbing Subcontractor. This Subcontractor is to carry all costs for core drilling. The Construction Manager will not be responsible for any circular penetrations required for the proper installation of the plumbing systems. Locate all required openings and prior to coring, coordinate the opening with the Construction Manager and all other trades. Do not disturb the existing systems. Thoroughly investigate the existing conditions in the vicinity of the required opening prior to coring. This Subcontractor shall be responsible for damages to the building and its systems from the coring operations. Disturbances from coring shall be kept to a minimum.

3.4 ~~MEDICAL GAS~~ AND DENTAL AIR INSTALLATION

A. The entire ~~medical gas~~ and Dental Air system shall be installed in accordance with NFPA 99-2010 except where amended by these specifications.

B. All tools used on medical gas/dental air piping shall be separate from tools used by other trades. Installers shall present certification documentation before beginning work.

C. The installation of equipment and individual components shall be made in accordance with the instructions of the manufacturer. These instructions shall be submitted to the owner and made part of the contract specifications.

D. All piping, valves, fittings and components for medical gas and medical vacuum use shall be supplied cleaned, prepared and certified for medical oxygen service by the manufacturer and be received sealed on the job.

E. Piping

1. Pipe shall be cut square with a tubing cutter with sharp cutting wheels. All burred ends of all piping and tubing shall be reamed to full bore of the pipe or tube and all chips shall be removed. Tools used in cutting and reaming shall be kept free from oil, grease or other lubricants not suitable for medical oxygen service. All cuts shall be cleaned and restored to original pipe dimensions. Where contamination has occurred, the items affected shall be re-cleaned in accordance with NFPA 99 2010. Joints shall be brazed within one hour of being cleaned.

2. All brazing shall be performed according to ANSI/AWS C3.4. Brazed joints shall be considered Class B brazed joints. While brazing, all joints shall be continuously purged with dry nitrogen.

3. During and after installation, openings in the piping shall be kept capped or plugged, except that during brazing, a discharge hole (holes) shall be provided to allow the discharge of purge gas. During brazing, the purge gas flow rate shall be maintained at a level that will not produce excessive positive pressures in the piping system. The flow of purge gas shall be

maintained until the joint is cool to the touch. After brazing, the discharge hole (holes) shall be plugged or capped.

4. All joints in the piping shall be made with silver bearing copper-phosphorus (BCuP) brazing alloy (melting point at least 1000 degrees F). The use of flux is prohibited. The outside of the tube and fittings shall be cleaned by washing with hot water and a stainless steel brush after brazing.

5. Each brazed joint shall be visually examined after cleaning. The following conditions shall be considered unacceptable:

   a. Flux or flux residue.
   b. Excessive oxidation.
   c. Presence of unmelted filter metal.
   d. Failure of the filler metal to be clearly visible all the way around the joint at the interface between the socket and the tube.
   e. Cracks in the tube or component.
   f. Cracks in the braze filler metal.
   g. Failure to hold the test pressure.

6. Defective brazed joints shall be replaced. No joint shall be repaired. Cracked joints or joints exhibiting excessive oxidation shall be replaced.

7. Threaded joints shall be kept to a minimum.

8. Identify and permanently mark all piping as it is installed with pre-approved labels and direction arrows. Labeling shall be applied at intervals of not more than 20 feet, at least once in each room and at each story traversed by the pipe. All labels must be positioned to be easily seen and read.

9. Piping shall be supported from the building structure in accordance with MSS Standard Practice SP-69, Piping Hangers and Supports - Selection and Application. Hangers and supports shall comply with MSS Standard Practice SP-58, Piping Hangers and Supports - Materials, Design and Manufacture. Portions of hangers in contact with copper tube shall have a copper finish or other protection against galvanic corrosion. Maximum support spacing shall be as follows:

_ in. nominal	5 ft.
½ in. nominal	5 ft.
¾ in. nominal	5 ft.
1 in. nominal	5 ft.
1¼ in. nominal	6 ft.
1½ in. nominal and larger	10 ft.

10. After installation of the piping, but before installation of the outlet valves, the lines shall be blown down (purged) by means of dry nitrogen. NOTE: Large lines should be purged before small lines are attached.

11. Change of direction in medical vacuum piping shall be made with T-fitting and cleanout plug. The cleanout shall be made with a wrought copper street male adapter with cast brass cap. The cleanout shall be accessible for rodding.

F. Valves and Gauges

1. Furnish and install any and all valves including purge valves, required to isolate sections of the piping systems extending into areas for construction at a later date. Provide all valves to properly test each system with respect to the construction phasing and as essentially indicated on the drawings. Provide all required adapters, valves and interconnecting tubing required to perform the medical gas testing as required by the University. Identify all isolation and phasing valves as such and indicate on tag or plastic sign that valve is to remain open and that anesthesia department is to be notified if closed.

2. Install isolation valves on laterals adjacent to risers.

3. Lock in open position all main, section, and riser valves.

4. ~~Zone valves (MGCV) services shall be in the following top to bottom sequence: oxygen, and medical vacuum. This sequence shall be maintained where two zone valve boxes are required for a given location~~.

3.5 ~~MEDICAL GAS~~ AND DENTAL AIR TESTING AND CERTIFICATION

A. General

1. This Plumbing Subcontractor shall be responsible for the testing of all medical ~~gas (oxygen, nitrous oxide &~~ dental air) systems as outlined in NFPA 99 2010. Note additional requirements contained within this specification as well as in NFPA-99.

2. The testing shall include all components of the system or portions thereof, including but not limited to, gas bulk sources(s), local alarms and monitoring safeguards, master alarms, pipelines, isolation valves, area alarms, zone valves, station outlets, and terminal outlets.

3. This subcontractor is to provide purge valves and isolation valves at all dead ends and points of connections to piping systems or at all phasing break points for the proper execution of testing and certification.

4. This subcontractor shall be responsible for supplying the bottled gas, gauges, adapters, analyzer and all other necessary equipment to conduct the testing and certification.

5. Testing shall be performed in the following sequence and shall be completed prior to use of the system for patient care.

6. COLUMN ACCEPTANCE TEST

   Purge test

   INSTALLATION TESTS

   Blowdown test
   Initial pressure test
   Cross-connection test
   Purge test
   Pressure test

   CERTIFICATION TESTS

   Cross-connection test
   Valve test
   Flow test
   Alarm test
   Purge test
   Purity test
   Gas source test
   Outlet Test
   Final tie-in test
   Operational pressure test
   Concentration test

7. All installation tests shall be performed by the installer or representative prior to the certification tests. Test gas shall be oil-free dry nitrogen.

8. All certification tests shall be performed and certified by an independent (not the installation contractor) medical gas testing contractor/laboratory. The testing contractor shall have a minimum of 5 years experience in the testing of medical gases. The testing laboratory used shall be state certified. The Plumbing Contractor shall hire the certification contractor directly. The testing contractor shall submit a shutdown management plan before any work is begun. Test gas, up to and including the purity test, shall be oil-free dry nitrogen. The balance of certification tests shall be with the gas of system designation. **The Plumbing Subcontractor shall assist as required the ~~Medical Gas~~ Certifier in all certifications.**

9. This subcontractor shall submit installation test reports and results to the architect/engineer or his representative for review. Installation test reports shall note date, time and pressure readings for tests sections as well as results of blowdown, purge and cross-connection tests for tested sections and outlets. Certification test reports, certified by the independent laboratory, shall note date and time of tests on a room-by-room, outlet-by-outlet, valve-by-valve, alarm-

by-alarm format.

B. Column Acceptance Test

1. Purge Test

a. In order to remove particulate matter in the pipelines, a heavy, intermittent purging of the pipe line shall be done. The appropriate adapter shall be obtained, and a high-flow purge shall be put on each outlet. The outlet shall be allowed to flow fully until the urge produces no discoloration in a clean white cloth.

C. Installation Tests

1. Blowdown Test

a. After installation of the piping but before installation of station outlets and other medical gas components, the lines shall be blown clear.

2. Initial Pressure Test

a. Before attachments of system components (e.g. pressure activating switches for alarms, manifolds, pressure gauges or pressure relief valves), station outlets, with test caps in place, and before closing walls and ceilings, each section of the piping system shall be subjected to a test pressure of 150 PSIG. This test pressure shall be maintained until each joint has been examined for leakage by means of soapy water or other equally effective means of leak detection safe for use with oxygen. The source shutoff valve shall be closed. Leaks, if any, shall be located, repaired and retested in accordance with this paragraph.

b. ~~Nitrogen systems shall be tested similarly, except test pressure shall be (250) PSIG~~.

3. Cross-Connection Test

a. Prior to closing the walls, it shall be determined that no cross-connection of piping systems exists. Test procedures shall be those as outlined in NFPA 99-2010.

4. Purge Test

a. In order to remove particulate matter in the pipelines, a heavy, intermittent purging of the pipe line shall be done. The appropriate adapter shall be obtained, and a high-flow purge shall be put on each outlet. The outlet shall be allowed to flow fully until the purge produces no discoloration in a clean white cloth.

5. Pressure Test

a. After the completely assembled station outlets and all other medical gas system components have been installed, all piping systems shall be subjected to a 24-hour standing pressure test at 20 percent above the normal operating line pressure. After the piping system is filled with the test gas, the supply valve and all outlets shall be closed and the source of test gas disconnected, the piping system shall remain leak-free for 24 hours. Leaks, if any, shall be located, repaired, and retested in accordance with this paragraph.

D. Certification Tests

1. Cross-Connection Test

a. After closing of walls and completion of installation tests, it shall be determined that no cross-connection of piping systems exists. Test procedures shall be those as outlined in NFPA 99-2010. Vacuum inlets shall be tested for cross-connections at this time.

2. Valve Test

a. Valves installed in each medical gas piping system shall be tested to verify proper operation and rooms, areas and outlets of control. Records shall be made listing the rooms, areas and outlets controlled by each valve for each gas. The information shall be utilized to assist and verify the proper labeling of the valves.

3. Flow Test

a. ~~Oxygen outlets~~ Dental Air outlets shall deliver 5 SCFM with a pressure drop of no more than 5 PSIG and maintain a residual pressure of 50 PSIG.

4. Alarm Test

a. All warning systems, including local alarms, area alarms and master alarms, shall be tested to ensure that all components function properly. Permanent records of these tests shall be maintained. Test limits shall be those as outlined in NFPA 99 2010.

5. Purge Test

a. In order to remove any traces of particulate matter deposited in the pipelines as a result of construction, a heavy, intermittent purging of the pipelines shall be done. Test procedure shall be as outlined in NFPA 99 2010.

b. For each positive-pressure gas system, cleanliness of piping system shall be verified. Filter a minimum of 35 cubic feet of gas through a clean, white 0.45 micron filter at a minimum flow of 3.5 SCFM. Filter shall show no discoloration, and shall accrue no more than 0.1 mg. of matter. Each outlet shall be tested with the outlet most remote from the zone valve to be the last outlet tested.

6. Purity Test

   a. For each positive-pressure system the test (source) gas shall be tested for dew point, total hydrocarbons (as methane), and halogenated hydrocarbons. The test results shall be utilized as noted below.
   b. For each positive-pressure system, each outlet shall be tested for dew point, total hydrocarbons (as methane) and halogenated hydrocarbons. The test results shall be utilized as noted below.
   c. Results of the source gas test and outlet tests as described above shall be compared. The maximum allowable variation between the test results shall be:

Dew point	5°C @ 50 PSIG
Total hydrocarbon as methane	± 1 PPM
Halogenated hydrocarbons	± 2 PPM

7. Final Tie-In Test

   a. After connection to the new system, this final connection shall be leak-tested with the gas of system designation at the normal operating pressures. This pressure shall be maintained until each joint has been examined for leakage by means of soapy water or other equally effective means of leak detection safe for use with oxygen.

8. Operational Test

   a. Oxygen outlets shall deliver 3.5 SCFM with a pressure drop of no more than 5 PSIG and residual pressure of 50 PSIG.

9. Concentration Test

   a. After purging each system with the gas of system designation, each pressure gas source and outlet shall be analyzed for concentration of gas by volume. Analysis shall be with instruments designed to measure the specific gas dispensed. Allowable concentrations shall be within the following:

Dental Air	99+% oxygen
~~Oxygen~~	~~99+% oxygen~~
~~Nitrous Oxide~~	~~99+% oxygen~~

3.6 ~~MEDICAL GAS~~ DENTAL CONNECTED EQUIPMENT

A. Furnish and install shutoff valves at each piece of equipment. Obtain exact roughing in dimensions from manufacturers of all service locations before connecting to or roughing for equipment.

B. Equipment shall be furnished and set under another Section of the Specifications. Roughing for and final connections to including piping shall be provided by this Contractor.

3.7 ~~MEDICAL GAS INSTALLERS~~

A. ~~All workers on medical gas systems must have the proper qualifications, certification and copies of licenses and certificates must be provided to the Owner prior to the start of the work. It is preferred that the installing contractor utilize a separate and distinct group of his workers dedicated to the medical gas system installation for the duration and completion of the project~~.

END OF SECTION

SECTION 230000 - HVAC

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PART 2- PRODUCTS

SECTION 230000 – HVAC

1 PART 1 – GENERAL

1.1 REFERENCES

A. All of the Contract Documents, including General and any Supplementary Conditions and Division 1- General Requirements, apply to the work of this Section.

B. Examine all Drawings and all other Sections of the specifications for requirements herein affecting the work of this trade

C. This specification requires a preparation and submissions of drawings and other documents, procurement of approvals and provision of a complete functional HVAC system. As a result, this Section serves dual purposes of providing specifications and indicating design criteria for the HVAC Subcontractors use and guidance in preparing HVAC installation drawings and other documents for approvals.

D. The bid for work under Section 15480 shall be included with this bid.

1.2 DEFINITIONS

A. Words in the singular shall also mean and include the plural, wherever the context so indicates and words in the plural shall mean the singular, wherever the context so indicates.

B. Wherever the terms “shown on drawings” are used in the specifications. They shall mean “noted”, “indicated”, “scheduled”, “detailed”, or any other diagrammatic or written reference made on the drawings.

C. Wherever the term “provide” is used in the specifications it will mean “furnish” and “install”, “connect”, “apply”, “erect”, “construct”, or similar terms, unless otherwise indicated in the specifications.

D. Wherever the term “material” is used in the specifications it will mean any “product”, “equipment”, “device”, “assembly”, or “item” required under the Contract, as indicated by trade or brand name, manufacturer’s name, standard specification reference or other description.

E. The terms approved”, or “approval” shall mean the written approval of the Architect.

F. The term “specification” shall mean all information contained in the bound or unbound volume, including all “Contract Documents” defined therein, including all drawings.

G. The terms “directed”, “required”, “permitted”, “ordered”, “designated”, “prescribed” and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect. The terms “approved”, “acceptable”, “satisfactory” and similar words shall mean approved by, acceptable or satisfactory to the Architect. The terms “necessary”, “responsible”, “proper”, “correct” and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.

H. "Piping" includes in addition to pipe or mains, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

I. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.

J. "Exposed" means not installed underground or "concealed" as defined above.

K. "HVAC Sub-Contractor", refers to the Sub-Contractor or his Sub-Contractors responsible for furnishing and installation of all work indicated in the HVAC specifications and as shown on the HVAC drawings.

1.3 SCOPE OF WORK

A. Work Included: The scope of work, without limiting the generality thereof, consists of furnishing all labor, materials, plant, transportation, equipment, accessories, appurtenances, and services necessary and/or incidental to the proper completion of all HVAC work shown on the drawings, described in the specifications, or as reasonably inferred from either, in the opinion of the Architect, as being required, and includes, but is not limited to:

All work in Section 15600 HVAC
Coordination with DDC control vendor
Insulation
HVAC equipment
Instructions to Owner
Core drilling
Furnishing of access panels
Building automation system connections
Testing, disinfection and certification
Connections to HVAC connected equipment furnished under other sections
Valves and accessories
Cleanouts
Boilers
Record coordination drawings - CADD Submission
Thermostatic master mixing valves
Hangers, sleeves and appurtenances
Interlocking and control wiring
Cleaning and adjusting
Staging, scaffolding and rigging
Seismic restraints
Assist in commissioning of systems
Installation of fireproofing sleeves
Miscellaneous iron and steel

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. Electrical Work - Section 16100.

B. Finish Painting - Section 09900.

C. Temporary power for operation of pipe cutting, welding and threading tools - Section 01500

D. Fire Protection Work - Section 15300.

E. Heating Work - Section 15600

F. Concrete housekeeping pads - Section 03300.

G. Installation of access panels - Trades in which they occur.

H. Excavation, backfill and resurfacing - Earth Work - Section 02200.

I. Drainage structures and appurtenances - Section 02700. Beyond 10 feet.

J. Toilet accessories - Section 10800.

K. Site utilities beyond 10 feet from building

L. Furnishing of fire stop material

M. Building Commissioning

1.5 CODES, STANDARDS AND REFERENCES

A. All materials and workmanship shall comply with all applicable State Codes, Specifications, Local and State Ordinances, Industry Standards, Utility Company Regulations and latest editions.

B. In case of difference between State Building Codes, State Laws, Local Ordinances, Industry Standards, Utility Company Regulations and the Contract Documents, the HVAC Subcontractor shall promptly notify the Architect in writing of any such difference.

C. In case of conflict between the Contract Documents and the requirements of any Code, Authorities having jurisdiction, the most stringent requirements of the aforementioned shall be included in the bid and assume that will be provided unless otherwise directed by the Architect after award of Contract.

D. Should the HVAC Subcontractor perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations, he shall bear all costs arising in correcting the deficiencies, as approved by the Architect.

E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations, and the applicable requirements of the following accepted Codes and Standards, without limiting the number, as follows.

1. Local and state building, HVAC, mechanical, electrical, fire and health department codes.
2. National Fire Protection Association (NFPA)
3. Occupational Safety and Health Act (OSHA)
4. Building Owner’s Insurance Company
5. Underwriters' Laboratories (UL)

6. International Building Code 2006 (including 2006 NH Supplement)
7. Recommendations of the National Fire Protection Association (NFPA), in general and in particular: Life Safety, NFPA 101, JCAHO – Joint Commission Accreditation Healthcare, JCAHO – Interim Life

F. In these specifications, references made to the following Industry Standards and Code Bodies are intended to indicate the accepted volume or publication of the Standard. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:

1.	ANSI	American National Standards Institute
2.	ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
3.	ASME	American Society of Mechanical Engineers
4.	ASTM	American Society of Testing Materials
5.	AWS	American Welding Society
6.	CS	Commercial Standards, U.S. Department of Commerce
7.	FM	Factory Mutual
8.	NFPA	National Fire Protection Association
9.	CGA	Compressed Gas Association
10.	FS	Federal Specification, U.S. Government
11.	HI	Hydraulics Institute
12.	MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
13.	NEMA	National Electrical Manufacturers Association
14.	OSHA	Occupational Safety and Health Act
15.	UL	Underwriters' Laboratories, Inc.

G. The HVAC Subcontractor for the work shall give all necessary notices, obtain all permits, pay all governmental taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. The HVAC Subcontractor shall obtain and pay for all required Certificates of Inspection for his work and deliver same to the Architect before request for acceptance of his portion of work is made and before final payment.

1.6 GUARANTEE

A. Attention is directed to provisions of the General Conditions and Supplementary General Conditions regarding guarantees and warranties for work under this Contract.

B. Manufacturers shall provide guarantees for work under this Contract. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and the Contractor may have by Law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the systems, as determined by the Architect and shall remain in effect for a period of (12) months thereafter.

C. All materials, items of equipment and workmanship furnished under each Section shall carry the standard warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the HVAC Subcontractor including all other damage done to areas, materials and other systems resulting from this failure.

D. The HVAC Subcontractor shall guarantee that all elements of the systems provided under his Contract, are of capacity to meet the specified performance requirements as set forth herein or as indicated on the drawings.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the HVAC Subcontractor, within (5) working days, at no cost to the Owner.

F. The HVAC Subcontractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

G. Upon final acceptance of the project by the Owner, the (1) year guarantee period of all equipment and materials will be initiated. During this period, the Contractor shall make a minimum of (2) visits to the site (6) months after acceptance and immediately prior to the end of the guarantee period). These visits shall be performed in the presence of the Owner's representative. During each visit, the Contractor shall thoroughly check all equipment for proper operation and respond to any list of deficiencies prepared by the Owner. Formal reports shall be generated and forwarded to the Department of Engineering and Architect's Office describing the systems inspected, date of inspection and status of equipment.

1.7 THE SUBCONTRACTOR

A. The HVAC Subcontractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications and shall take all responsibility for and bear all losses resulting to him in the execution of his work.

B. The HVAC Subcontractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed directly or indirectly by the HVAC Subcontractor shall perform their work according to all the conditions as set forth in these specifications.

C. The HVAC Subcontractor shall furnish all materials and do all work in accordance with these specifications and any supplementary documents provided by the Architect. The work shall include every item shown on the drawings and/or required by the specifications as interpreted by the Architect. All work and materials furnished and installed shall be new and of the best quality and workmanship. The HVAC Subcontractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed

1.8 COORDINATION OF WORK

A. The HVAC Subcontractor shall compare his drawings and specifications with those of other Trades as well as the Architectural drawings and specifications, and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the HVAC work. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, HVAC Subcontractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the HVAC work caused by the HVAC Subcontractor's neglect, shall be made by him at his own expense, to the Architect's satisfaction. The HVAC Subcontractor must include in his bid sufficient dollar amounts to coordinate the work of this Contract. This project is complex and will require additional time to coordinate all Trades and allow implementation of Yale New Haven Hospital Standards and maintenance serviceability requirements. This requirement shall include, but not be limited to, producing the coordination drawings, as many times and as many drawings as required, to ensure serviceability of equipment, as approved by the Owner.

B. Locations of pipes and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. The HVAC Subcontractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component.

C. Lines which pitch shall have the right-of-way over those which do not pitch, For example: waste piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.

D. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The HVAC Subcontractor shall provide cleanouts and drains as required for his work to effect these offsets, transitions and changes in direction.

E. All work shall be installed in a way to permit removal (without damage to other parts) of coils, filters, control appurtenances, shafts, sheaves and drives and all other system components provided under this Contract requiring periodic replacement or maintenance. All piping shall be arranged in a manner to clear the openings of swinging overhead access doors as well as ceiling tiles. All work shall be done to allow easy access for maintaining equipment. The Owner and Engineer will require proof via the preparation of large scale sections and part plans that valves, cleanouts, etc. are accessible after the work is completed. Any items in the field discovered to be in non-compliance shall be removed and relocated, as required, and as directed by the Architect.

F. The Contract Drawings are diagrammatic only intending to show general runs and locations of piping, equipment, terminals and specialties and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom.

G. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, flow switches, etc., exist, such conflicts shall be reported to the Architect during bidding and prior to signing of the Contract. If such action is not taken, the HVAC Subcontractor shall furnish such items as part of his work as necessary, for complete and operable systems and equipment, as determined by the Architect.

H. The HVAC Subcontractor shall coordinate the installation of all equipment and any catwalks or service platforms provided.

I. Where drawing details, plans, specification requirements and/or scheduled equipment capacities are in conflict and where pipe sizes of same pipe are shown to be different between plans and/or between plans and sections or details, the most stringent requirement will be included in the Contract. HVAC systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.

J. Final location of all exposed control valves, access panels, fixtures, control devices, wall hydrants, hose bibbs etc., shall be coordinated with the Architectural reflected ceiling plans and/or other Architectural details, as applicable. Obtain approval of locations of all devices from Architect in the field. Equipment shown on the HVAC and/or Architectural drawings to be

provided with services, shall be included under this Contract as applicable, including all piping connections to systems, to make equipment complete and operable. Additional piping, flexible fittings, etc., shall be provided to accomplish the above requirement, as required, all as part of this Contract, at no extra cost to the Owner. This requirement necessitates that the HVAC Subcontractor review the architectural drawings and the drawings of other Trades during bidding to ascertain the extent of all requirements, and interface between the Trades and scope of work.

K. The HVAC Subcontractor shall coordinate his work with other Trades' work so that all equipment and systems can be easily, safely and properly serviced and maintained. It is imperative that service personnel can safely access all equipment. Provide safety rails, steps, ladders, valve chains, handle extensions, etc. as required, in addition to the ones shown on the drawings, to ensure safe and easy access to all equipment and is provided in a manner approved by the Architect and the Owner's Project Manager

1.9 GIVING INFORMATION

A. The HVAC Subcontractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the Architect and other Contractors sufficiently in advance of the work so that all openings may be built in advance.

1.10 EQUIPMENT AND MATERIALS

A. Equipment and materials shall be delivered to the site and stored in location as directed by the Architect, in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls, filters, etc., shall be stored in dry, heated spaces.

B. The HVAC Subcontractor shall have his equipment tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned, polished thoroughly and turned over the Owner in a condition satisfactory to the Owner and Architect. Damage or defects developing before acceptance of the work shall be made good at the HVAC Subcontractor's expense.

C. The HVAC Subcontractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.

D. The manufacturers listed within this specification establish the standards of quality required, either by description or by references to brand name, name of manufacturers or manufacturer's model number. Where one product only is specifically identified by name or manufacturer's model number, the HVAC Subcontractor shall base his bid on the use of the name product. Where multiple names are used, the HVAC Subcontractor shall base his bid on the use of any of those products named. The HVAC Subcontractor shall submit with his bid, the names of products which are proposed as substitutions for products named in the specifications. Each proposed substitution shall be accompanied by a written statement of money to be added or deducted from his bid. The Owner reserves the sole right to accept or reject said substitutions with or without cause. When equipment and/or materials are proposed to be purchased from a manufacturer other than those specified, the HVAC Subcontractor shall provide with his bid, data sufficient to inform the Owner and Engineer of the basis of equality of the substitution to that of the equipment and/or materials specified. When equipment other than that specified is used, the HVAC Subcontractor shall be solely responsible for any extra cost of required

revisions such as structural steel, concrete, electrical, piping, and any engineering review, coordination with other Trades, or redesign, etc. Such additional cost shall be identified at the time such substitutions are proposed and incurred by the HVAC Subcontractor.

E. Manufacturers' directions shall be followed completely in the delivery, storage, protection and installation of any equipment. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's written instructions before proceeding with the work. Should the HVAC Subcontractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.

F. The HVAC Subcontractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.

F. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of the HVAC Subcontractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, the HVAC Subcontractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the HVAC Subcontractor shall make all necessary changes in all affected related work provided under other Sections including location of roughing-in connections by other Trades, electrical requirements, piping, supports, insulation, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.

H. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. Equipment and materials shall be products which will meet with the acceptance of the Authorities having jurisdiction over the work and as specified hereinbefore. Where such acceptance is contingent upon having the products listed or labeled by FM, UL or other testing laboratories, the products shall be so listed or labeled. Where no specific indication as to the type or quality of material or equipment is indicated, a first class standard article shall be provided.

I. All equipment of one type (such as valves, piping, heaters, well water system components, drainage specialties, etc.), shall be the product of one manufacturer.

J. Equipment furnished by the Owner, if assigned to the HVAC Subcontractors, shall be received, inspected, installed, etc., as if they were purchased by the HVAC Subcontractor. All guarantees, service contracts, etc., shall be the same as for all other equipment provided under this Contract. Make all connections, and provide all piping and controls as necessary.

1.11 CUTTING AND PATCHING

A. The HVAC Subcontractor shall be responsible for all core drilling, as required for work under his Contract, but in no case shall he cut into any structural elements without the written approval of the Architect.

B. All cutting, rough patching and finish patching shall be provided under this Contract.

C. All concrete and masonry equipment bases and pads shall be provided by the Other Work Contractor.

1.12 USE OF PREMISES

A. The HVAC Subcontractor shall confine all of his apparatus, storage of materials and construction to the limits indicated on the drawings and directed by the Architect and he shall not encumber the premises with his materials.

B. In storing materials within areas (structure or ground), or when used as a shop, the HVAC Subcontractor shall consult with the other work Contractor and shall restrict his storage to space designated for such purposes. The HVAC Subcontractor will be held responsible for repairs, patching or cleaning arising from any unauthorized use of premises.

C. Notwithstanding any approvals or instructions which must be obtained by the HVAC Subcontractor from the Architect in connection with use of premises, the responsibility for the safe working conditions at the site shall remain the HVAC Subcontractor's and the Architect or Owner shall not be deemed to have any responsibility or liability in connection therewith.

1.13 PROTECTION

A. All materials such as valves, fittings, piping, etc., shall be properly protected and all piping openings shall be temporarily closed by the HVAC Subcontractor installing same, so to prevent obstruction and damage. The HVAC Subcontractor shall take precautions to protect his materials from damage and theft.

B. The HVAC Subcontractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or electrical systems provided under his Contract.

1.14 DAMAGE TO OTHER WORK

A. The HVAC Subcontractor shall be held responsible and shall pay for all damages caused by his work to the new building structures and equipment, piping, etc., and all work and finishes installed under this Contract in the new or in existing building. Repair of such damage shall be done as hereinbefore specified, at the expense of the HVAC Subcontractor and to the Architect's satisfaction.

1.15 CORRECTION OF WORK

A. The HVAC Subcontractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after completion of work and whether or not fabricated, installed or completed. The HVAC Subcontractor shall bear all costs of correcting such rejected work.

B. The above requirements will also apply to work observed to be in conflict with 15400-1.8 "Coordination of Work" as it relates to installations not allowing accessibility to all system components.

1.16 EXTRA WORK

A. No claim for extra work will be allowed unless it is authorized by the Architect in writing before commencement of the extra said work.

1.17 TOUCH-UP PAINTING

A. The HVAC Subcontractor shall thoroughly clean all equipment and systems provided under this Contract from rust, splatters and other foreign matter or discoloration, leaving every part of each system in an acceptable prime condition. The HVAC Subcontractor, for the work under his Contract, shall refinish and restore to the original condition all equipment and piping which has sustained damage to the manufacturer's prime and finish coats of paint and/or enamel.

1.18 PIPE SLEEVES, PLATES AND ESCUTCHEONS, FIRESTOPPING AND SMOKEPROOFING

A. Where pipes pass through all walls and floors, the HVAC Subcontractor shall provide and set individual sleeves for each pipe and all other work under his charge, as necessary for passage of all pipes. Sleeves shall be of sufficient size to provide 1/2" air space around the pipe passing through (including insulation where pipes are insulated). Where pipes are to be insulated, insulation shall run continuous through sleeves. All openings shall be sealed, smokeproofed and made tight. The HVAC Subcontractor shall be responsible for the exact location of sleeves provided under this Contract and shall coordinate all requirements for piping sleeves.

B. The HVAC Subcontractor, for work under his charge, shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation, and he shall prepare sleeving and opening drawings for the use of these drawings by the other work contractor.

C. Sleeves and inserts shall not be used in any portions of the building, where their use would impair the strength or construction features of the building. Elimination of sleeves must be approved by the Architect.

D. Provide chrome-plated brass escutcheons with set screw for exposed piping, in all areas except in mechanical rooms. In these areas use plain brass or cast iron escutcheons suitable for painting. All escutcheons shall be sized to fit the bare pipe or insulation in a snug and neat manner. They shall be of sufficient size to cover sleeved openings for the pipes and of sufficient depth to cover sleeves projecting above floors. Escutcheons shall be as manufactured by Beaton & Caldwell, Dearborn Brass or Grinnell.

E. Pipe sleeves shall be required on all pipes passing through all walls and shall be made of Schedule 40 pipe, 16 gauge galvanized steel or 16 gauge steel as follows:

1. Sleeves on pipes passing through masonry or concrete construction shall be Schedule 40 pipe.
2. Sleeves on pipes passing through drywall construction shall be 20 gauge galvanized steel.
3. Sleeves on pipes passing through fire rated drywall partitions shall be 16 gauge steel.
4. Exterior wall sleeve through masonry walls shall be made watertight by the use of Mechanical Link Seal Joint as MFG by Century Products MFG.

F. Pipe sleeves shall be set as follows:

1. Set sleeves 1" above finish floor (3" at penthouses and mechanical rooms) and flush on each side of walls, except sleeves through floor occurring in walls and partitions shall terminate 1" above the finished floor.
2. Sleeves shall be set securely in place before concrete is poured.

G. The HVAC Subcontractor shall firestop or smokestop the space between the sleeves provided under his Contract and pipes as applicable, as follows:

1. Materials shall bear label issued by qualified laboratory and specifically indicating that the product has been tested to ASTM E814 Standard, shall be as manufactured by Bio Fireshield Inc. or Dow Corning Corp., and shall include the following:
   a. Dow Corning silicone RTV foam (penetration fill material) complete.
   b. Dow Corning 96-081 RTV silicone adhesive sealant.
   c. Mineral fiber board, mineral fiber matting, and mineral fiber putty may be utilized for forming and damming materials used to contain the liquid silicone RTV foam mixture prior to and during foam-filling penetrations. Damming and forming materials shall be fire tested and functionally approved and shall be capable of being left in place to become an integral part of the foamed penetration wall.

2. Materials shall be delivered in their original, tightly sealed containers or unopened packages, all clearly labeled with the manufacturer's name, product identification and lot numbers where appropriate.

3. Installation shall comply with the following:
   a. Penetration seal preparation shall include use of the procedures, techniques and quality control standards recommended by the product manufacturer, as follows:
   b. Remove all incidental combustible materials and loose impediment from the penetration opening and involved surfaces.
   c. Remove free liquids or oil from all involved surfaces and penetration components.
   d. Install the specified damming materials to accommodate and insure the proper thickness/fire rating requirements and provide containment during foaming.
   e. Foam mixing and dispensing of equipment and materials shall be in strict accordance with manufacturer's instructions.
4. The materials installation procedures, clean-up, safety precautions and requirements shall be in accordance with Dow Corning published information relative to "Safe Handling Procedures", use of safety shoes, goggles, etc.

5. All firestopping materials must be applied in direct accordance with their UL label certification.

6. The HVAC Subcontractor shall submit a mockup of every type of firestopping method used on this project for approval by the Architect at the site. The firestopping methods must be approved prior to installation of systems.

H. Except as otherwise specified, underground piping passing through exterior walls, foundation slabs on grade, or manhole walls, shall have penetration closures of the modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous belt around the pipe and with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between the pipe and wall, reducing chances of cathodic reaction between these members. The HVAC Subcontractor for work under his charge shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation. The inside diameter of the wall

opening shall be sized to fit the pipe and ensure a watertight joint. Where applicable, when installing seals, take into account the pipe O.D. if non-standard due to coating or jacketing.

1.19 WATERPROOFING, FLASHING AND COUNTERFLASHING

A. Unless specifically indicated otherwise on the drawings, the HVAC Subcontractor shall provide all counterflashing and waterproofing of all piping and equipment provided by him, which pierce roofs, walls and other weatherbarrier surfaces. All work under this Section shall be coordinated with the Other Work Contractor.

B. All work shall be performed in a workmanlike manner to ensure weatherproof installation. Any leaks developed due to this Contractor's work shall be repaired at his expense, to the Architect's satisfaction.

C. Pipes passing through slabs shall have the sleeve extended above floors as hereinbefore specified to retain any water and the space between the pipe and sleeve caulked with lead wool. The top shall be sealed with lead and the bottom shall be sealed with monolastic caulking compound.

C. Subcontractor shall provide and install counterflashing to overlap the base flashing by 4". Flashing shall be fastened with matching clamp rings or by brazing, welding or soldering.

1.20 MISCELLANEOUS IRON AND STEEL

A. The HVAC Subcontractor shall provide all steel supports and hangers as shown on the drawings or required to support all equipment, systems or materials provided under this Contract.

B. All work shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets and framework shall be properly sized and strongly constructed.

C. Measurements shall be taken on the job and worked out to suit adjoining and connecting work. All work shall be done by experienced metal-working mechanics. Members shall be straight, true and accurately fitted.

D. Welded joints shall be ground smooth where exposed. Drilling, cutting and fitting shall be done as required to properly install the work and accommodate the work of other Trades as directed by them.

E. Members shall be generally welded except that bolting may be used for field assembly where welding would be impractical. Welders shall be skilled and certified. Bolts, nuts and washers shall be high tensile type, minimum 3/4" diameter, conforming to ASTM.

F. All shop and field fabricated iron and steel work shall be cleaned and dried and given (1) coat of rust inhibiting paint on all surfaces and in all openings and crevices.

1.21 ELECTRICAL WORK, MOTORS, MOTOR CONTROLLERS

A. The Electrical Subcontractor shall provide power wiring to all equipment provided under Section 15600. All control wiring shall be installed in conduits and in accordance with the respective equipment manufacturer requirements. All connections shall be provided by the

HVAC Subcontractor. All conduit and wiring provided by the HVAC Subcontractor shall be installed in accordance with the requirements of Section 16100 of these Specifications.

B. Motors shall be built in accordance with latest Standards of NEMA and as specified. Motors shall be specifically and expressly wound for voltage required.

C. Motors shall be tested in accordance with ANSI 50 and conform thereto for insulation resistance and dielectric strength.

D. Motors shall be provided with adequate starting and protective equipment as specified or required and with conduit terminal box of size adequate to accommodate conduits and wires.

E. Capacity shall be sufficient to operate motors under job conditions of operation and load, without overload and shall be at least the horsepower size indicated or specified.

F. All motors shall be suitable for continuous duty at rated horsepower, with temperature rise not to exceed 40°C for dripproof motors, 50°C for splashproof motors, 55°C for totally enclosed motors. All motors shall be capable of 15% overload without overheating.

G. Direct connected motors shall be furnished with adjustable base. Motors connected to driven equipment by belt or shaft shall be furnished with adjustable sliding bases, except for fractional motors which shall be furnished with slotted mounting holes.

H. Motors smaller than 1/2 HP shall be capacitor, starter or split-phase type. Motors 1/2 HP and larger shall be squirrel cage, induction type. Motors 1 HP and larger shall have grease lubricated ball bearings and approved grease fittings.

I. All electrical apparatus and controls furnished as a part of the HVAC work shall conform to applicable requirements under Electrical Section.

J. The HVAC Subcontractor shall provide the Electrical Subcontractor with all motor size and wiring requirements within (15) days from date of Contract to allow proper coordination of Trades by the other work Contractor.

K. The HVAC Subcontractor shall verify with the Electrical Subcontractor available electrical characteristics before ordering any equipment or motors.

L. Equipment which includes a number of correlated electrical control devices mounted in a single enclosure or on a common base with equipment, shall be supplied for installation completely wired internally with terminal strip ready for external wiring. Unless specifically directed otherwise in the Contract Documents, if these control devices are separately mounted they shall be furnished by the HVAC Subcontractor and wired by Electrical Subcontractor in accordance with the manufacturer's wiring diagram, as shown on the drawings and as specified hereinafter.

1.22 IDENTIFICATION OF MATERIALS

A. All equipment used in the HVAC systems shall have a permanently attached nameplate identifying the manufacturer, service, size, serial number or model number, etc. The nameplates shall be kept clean and readable at all times.

B. Each item of equipment such as pumps, air compressors, vacuum pumps, etc., shall be identified by a permanently attached nameplate made of black surface, white core laminated bakelite with 1" high indented letters. Nameplates shall be minimum 5" long by 3" wide and bear the equipment name as designated in the specifications. Nameplates shall be as fabricated by Seton Nameplate Co., Atlantic Engraving Co., W.H. Brady Co., or approved equal. Attach with screws or rivets only.

C. A legend showing the service and an arrow indicating the direction of flow shall be applied on each pipe installed by the HVAC Subcontractor. Indication shall be by stencil and paint only, no "stick-ons" will be allowed.

D. The piping of each system shall be identified in the following locations and where directed by the Architect.

1. Pipe mains and branches - every 15’-0”.
2. At each valve.
3. Each wall penetration (both sides).
4. Each riser including branch risers from mains.
5. At each piece of equipment.

E. The identification of piping shall be coordinated with the Owner and comply with OSHA and ANSI A13.1 Standards for the identification of systems. Obtain approval of Architect prior to installation. The letter size and background color shall conform to the ANSI Scheme for the Identification of Piping Systems.

F. Provide all labels on all vents thru roof.

G. Close attention shall be paid to all vent vent piping including that piping which penetrates roof. - This piping must be identified, including all vent penetration through the roof.

1.23 VALVE TAGS, NAMEPLATES AND CHARTS

A. All valves on pipes of every description shall be provided with neat circular brass valve tags of at least 1 1/2" in diameter, attached with brass hook to each valve stem or handle as determined by Architect. Tags shall be provided by the HVAC Subcontractor for the work under his charge. Stamp on these valve tags, in letters as large as practical, the number of the valve and the service, such as "HW", "HWC", "CW", ", for hot water, hot water circulation, cold water. The numbers of each service shall be consecutive. Obtain approval of Architect prior to installation. All pipe system valves to be tagged.

B. All valves on equipment shall be numbered by 3" red metal discs with 2" high white numbers secured to stem of valves by means of brass hooks or small link brass chain.

C. These numbers shall correspond to numbers indicated for valves on the Record Drawings and on (2) printed detailed lists. These printed lists shall state the numbers and locations of each valve and the equipment or system which it controls and other necessary information such as requiring the opening or closing of another valve or valves when any one valve is to be opened and closed.

D. These printed lists shall be prepared in form to meet approval of the Architect and shall be framed under glass. Provide valve lists in booklet form also and submit (6) copies to the Architect.

E. Nameplates, catalog numbers and rating identification shall be securely attached to mechanical equipment with screws or rivets. Adhesives or cements will not be permitted.

F. The HVAC Subcontractor shall provide for his work all valve charts including his name and telephone number; date of chart; name and telephone number of Architectural Firm and Consulting Mechanical Engineering Firm and the Owner's representative.

G. This information must be submitted on electronic file format also.

1.24 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

A. The HVAC Subcontractor shall thoroughly instruct the Owner's operating personnel, to the complete satisfaction of the Architect, in the proper operation of all systems and equipment provided by him. The HVAC Subcontractor shall make arrangements, via the Other Work Contractor, as to whom the instructions are to be given in the operation of the basic and auxiliary systems and the periods of time in which they are to be given. The Architect and Owner shall be completely satisfied that the Owner's representative has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by the HVAC Subcontractor to the Owner's representative, then the HVAC Subcontractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this paragraph of the specification has been complied with. All time required for Owner's instruction to satisfy the above requirements shall be included in this Contract. No extra compensation for such instructions will be allowed.

B. The HVAC Subcontractor shall submit to the Architect for approval, a total of (6) typed sets, bound neatly in 3-ring loose-leaf binders, of all instructions for the installation, operation, care and maintenance of all equipment and systems. Information shall indicate possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each section such as valves, water boosters, pure water systems, etc., shall be clearly divided from the other sections. A sub-index for each section shall also be provided. The methodology of setting-up the manuals shall be submitted to the Architect and Owner through the Contractor for approval prior to final submission of manuals.

C. The instructions shall contain information deemed necessary by the Architect and shall include, but not be limited, to the following:

1. Instructional classes on equipment and systems operation for Owner's representative and maintenance personnel, by engineering staff of HVAC Subcontractor. Minimum of ten (10) hours of instruction. Instruction shall include:

    a. Explanation of manual and its use.
    b. Summary description of the HVAC systems.
    c. Purpose of systems.

    All training classes and equipment instruction shall be videotaped on VHS format by the HVAC Subcontractor. Provide (3) copies of all tapes to the Owner and one to the Architect. At the Owner's discretion, the HVAC Subcontractor provide ten (10) additional hours of instructions up to one year after the building has been occupied.

2. System

    a. Detailed description of all systems.
    b. Illustrations, schematics, block diagrams, catalog cuts and other exhibits.

3. Operations

   a. Complete detailed, step-by-step, sequential description of all phases of operation for all portions of the systems, including start-up, shutdown, adjusting and balancing. Include all posted instruction charts.

4. Maintenance

   a. Parts list and part numbers.
   b. Maintenance, lubrication and replacement charts and Contractor's recommendations for preventive maintenance, as applicable to his work.
   c. Troubleshooting charts for systems and components.
   d. Instructions for testing each type of part.
   e. Recommended list of on-hand spare parts.
   f. Complete calibration instructions for all parts and entire systems.
   g. Instruction for charging, filling, draining and purging, as applicable.
   h. General or miscellaneous maintenance notes.

5. Manufacturer's Literature

   a. Complete listing for all parts.
   b. Names, addresses and telephone numbers.
   c. Care and operation.
   d. All and only pertinent brochures, illustrations, drawings, cuts, bulletins, technical data, certified performance charts and other literature with the model actually furnished to be clearly and conspicuously identified.
   e. Internal wiring diagrams and engineering data sheets for all items and/or equipment furnished under each Contract.
   f. Guarantee and warranty data.

6. The HVAC Subcontractor shall furnish instructions for lubricating each piece of equipment installed by him. Instructions shall state type of lubricant, where and how frequently lubrication is required. Frame instructions under glass and hang in a location as directed by Architect.

7. Information must be submitted on electronic file also

1.25 MANUFACTURER'S REPRESENTATIVE

A. The HVAC Subcontractor shall provide, at appropriate time or as directed by the Architect, the on-site services of a competent factory trained Engineer or authorized representative of particular manufacturer of equipment such as for the domestic water booster pump, ejectors, hot water heater, pumps, etc., provided under this Contract, to instruct the Owner, inspect, adjust and place in proper operating condition any item provided by him, as applicable. A minimum, system start-up shall start 90 days prior to scheduled building occupancy or at construction managers discretion.

B. The HVAC Subcontractor, as applicable, shall start-up and set in operating condition all major equipment and systems, such as the domestic water booster pump, water heaters, ejectors, well water pumps, etc., in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. In no case will major systems and

equipment be activated by any of the Subcontractor's, without the assistance or presence of the equipment manufacturer representative.

C. A written report shall be issued by the particular equipment manufacturer and the HVAC Subcontractor summarizing the results of the commissioning and performance of each system for the Architect's record. No additional compensation will be allowed for any Contractor for such services.

1.26 CONNECTIONS TO EQUIPMENT

A. The HVAC Subcontractor shall provide all pipe connections to equipment provided under other Sections of the specifications as shown on the Architectural Planning, and/or HVAC drawings and herein specified (sterilizers, autoclaves, ice machines etc.), including final connections to equipment, to result in a complete system, fully operational. The HVAC Subcontractor shall also make connections to Owner furnished or relocated equipment as specified above. Coordinate location of all equipment with Architect and Other Work Contractor. Obtain installation diagrams and methods of installation of all equipment, from manufacturers. Follow instructions strictly. If additional information is required, obtain same from Architect.

1.27 COORDINATION DRAWINGS

A. Before materials are purchased, fabricated or work is begun, each Subcontractor shall prepare coordination drawings for all floors/areas, including buried systems/services (all-Trade-composite at 3/8 inch scale), showing the size and location of his equipment and lines, in the manner described herein under General Requirements - Section 01040.

B. Coordination drawings are for the architect’s use during construction and shall not be construed as shop drawings or as replacing and shop drawings. The coordination drawings, when corrected for actual “as-built” conditions, will be reviewed by the Architect, corrected and become the Record Drawings to be submitted to the Owner for his use.

C. The cost of producing and reproducing the drawings will be included under the Contract of each Trade, including the cost or preparation of the Architectural building outlines. The Contractor shall take the lead to produce the Architectural backgrounds, show all ductwork, piping, etc., and circulate the drawings to any of his Subcontractors and the other Trades (HVAC, Fire Protection, Electrical), so that they can indicate all their work as directed by the Architect as required, to result in a fully coordinated installation.

D. In addition to the regular coordination drawing review, the HVAC work will also be reviewed by the Architect/Engineer to ensure that the system and equipment arrangements are suitable to provide maintenance access and service as follows:

1. Valves and instrumentation should be grouped where possible and positioned in accessible locations.

D.Prepare a complete set of computer based AutoCad 2005 drawings at scale not less than 3/8" equals 1'-0", showing basic layout for the structure and other information as needed for preparation of Coordination Drawings. The drawings shall indicate the layout of all specialty tradework as indicated herein and shall be designated as Coordination Drawings. The Contractors can purchase a copy of the floor plans on disk from the engineer to assist in the preparation of Coordination Drawings. The Contractor shall provide a minimum of two (2)

weeks notice to the engineer for the preparation of the disk. A signed liability release form will be required from the Contractor prior to the release of the disk from the engineer.

F. Highlight all fire rated partitions on the Coordination Drawings for appropriate coordination.

G. The main paths for the installation or removal of equipment from mechanical and electrical rooms shall be clearly indicated on the Coordination Drawings.

H. Each of the specialty trades shall add its work to the base drawings with appropriate elevations and grid dimensions. Specialty trade information shall be required for mechanical rooms, horizontal exits from HVAC closets, crossovers and for spaces in the above ceilings where congestion of work may occur such as corridors and, where required, entire floors. Drawings shall indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions and other services. Indicate elevations relative to finish floor for bottom of ductwork and piping and conduit 6" greater in diameter.

1. Specialty Trade shall include:

a. HVAC system.
b. piping and equipment
c. Electrical
d. Sheet Metal Work
e. Sprinkler System
f. ATC system
g. Medical gas/vacuum

I. Upon completing their portion of the Coordination Drawings, each specialty trade shall sign, date and return Coordination Drawings to the Contractor.

J. Where conflicts occur with placement of materials of various trades, the General Contractor shall be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialized and dated by the affected specialty trade subcontractor. The General Contractor shall then final date and sign each drawing.

K. Fabrication shall not start until Coordinate Drawings have been distributed to all parties as indicated herein.

L. Format: Coordination Drawings (plans only) shall be done using CAD in AutoCAD 2005 in either IBM or Mac Format, disks shall be given tot he architect for future transfer to Owner. Coordination Drawings will be used as base for as-built drawings.

M. Distribution of Coordination Drawings:

1. The General Contractor shall provide one print of each Coordination Drawing to:

a. Each specialty trade Subcontractor.
b. Owner
c. Construction Manager
d. Architect (for record purposes).

N. After distribution:

1. The method used to resolve interferences not previously identified shall be as in paragraph F. above. Distribute revised Coordination Drawings to all parties listed above.

O. Coordination Drawings include but are not necessarily limited to:

1. Structure
2. Partition/room layout, including indication of smoke and fire resistance rated partitions.
3. Ceiling layout and heights
4. Light fixtures.
5. Access Panels
6. Sheet metal, heating cols, boxes, grilles, diffusers, etc.
7. All heating piping and valves.
8. Smoke and fire dampers.
9. Soil, waste, vent piping, and conductor
10. All water systems.
11. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit. Motor control centers, starters and disconnects.
12. Sprinkler piping and heads.
13. All equipment, including items in the Contract as well as O.F.C.I. and O.F.I. items.
14. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur indicates areas in which the required access area may be greater than the suspected grid systems.
15. Medical Gas Systems

1.28 RECORD DRAWINGS

A. The HVAC Subcontractor shall maintain current at the site a set of his drawings on which he shall accurately show the actual installation of all work provided under his Contract indicating any variation from the Contract Drawings, in accordance with the General Conditions and Supplementary General Conditions. Changes whether resulting from formal change orders or other instructions issued by the Architect shall be recorded. Include changes in sizes, location and dimensions of piping, equipment, etc.

B. Utilizing the coordination drawings described herein before, the HVAC Subcontractor shall modify/correct/edit the HVAC work on the above CAD coordination drawings, to obtain a "CAD" set of Record Drawings. Also include (2) blackline prints, and CDX CAD files of entire record drawings..

C. A marked-up and colored-up set of prints on-site will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner's representatives and they shall be corrected if found either inaccurate or incomplete. This procedure is mandatory.

D. Coordination drawings are for the Contractor's, Architects and Owner's use during construction and shall not be construed as replacing any shop drawings. The CAD coordination drawings, when corrected for actual "as-built" conditions, will be reviewed by the Architect, corrected and will be used to formulate the Record Drawings to be submitted to the Owner for his use.

E. The HVAC Subcontractor shall submit a set of CAD files on disc marked "AS-BUILTS". All costs associated with the production and reproduction of the CAD files shall be included under the HVAC bid for work under the HVAC contracts.

1.29 ELECTRICAL ROOM REQUIREMENTS

A. The HVAC Subcontractor shall not install any piping or equipment in or through electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms, unless piping or equipment is intended to serve these rooms. If the HVAC Subcontractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.

B. Where piping carrying liquid or gas is routed to within 12" of any electrical panels or packaged equipment controllers, the HVAC Subcontractor shall provide galvanized sheet metal drain pans below such piping. The drain pans shall be constructed of minimum 18 gauge G-90 galvanized sheet metal with all joints sealed watertight. Extend 1 1/4" copper drain piping, with dielectric union to nearest floor drain.

1.30 HOISTING EQUIPMENT AND MACHINERY

A. All hoisting equipment and machinery required for the proper and expeditious prosecution and progress of the work under this Contract shall be furnished, installed, operated and maintained in safe condition by the HVAC Subcontractor for his material and/or equipment delivered to the designated hoisting area. All costs for hoisting operating services shall be borne by the HVAC Subcontractor, for all equipment and work under his charge.

1.31 STAGING

A. All staging, exterior and interior for HVAC work shall be furnished and erected by the HVAC Subcontractor and maintained in safe condition by him for proper execution of his work.

1.32 SUBMITTALS

A. Prepare and submit shop drawings in accordance with the requirements hereinbefore specified, and of Division 0 and applicable parts of Division 1 and in the manner described therein, modified as noted hereinafter.

B. All shop drawings shall have clearly marked the appropriate specification number, drawing designation, project name, etc., for identification of the submittal.

C. Disposition of shop drawings shall not relieve the HVAC Subcontractor from the responsibility for deviations from the drawings or specifications, unless he has submitted in writing a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Architect, nor shall such disposition of shop drawings relieve the HVAC Subcontractor from responsibility for error in shop drawings or schedules.

D. HVAC contractor shall provide all submittals and shop drawings as noted in the HVAC specifications and receive approvals before ordering equipment.

E. HVAC contractor scope shall include all ATC work, whether done directly or by a separate entity sub contracted by the HVAC contractor. This scope includes providing all submittals,

shop drawings, schematics, sequences, equipment cuts, etc. This scope includes integrating the HVAC equipment with the ATC system for a fully functional system and commissioning all as a working package.

F. HVAC contractor scope shall include all air and water balancing, whether done directly or by a separate entity sub contracted by the HVAC contractor. The test, adjust and balancing shall include all certifications and requirements noted in the specifications and such certifications shall be provided as a submittal along with all other HVAC submittals and shop drawings.

G. Shop drawing data shall include, but not be limited to, the following:

1. Manufacturer's model and catalog data.
2. Complete connection diagrams for all Trades.
3. Dimensions, capacities, ratings, materials, finishes, etc.

H. Each shop drawing is required to bear the review stamp of each Contractor associated with installing the equipment and/or processing the document.

I. Shop drawings shall include, but shall not be limited to, the following:

1. HVAC work layout, including location and sizes of piping, valves, drains, and all other accessories.
2. Equipment Cuts For:

a. Valves, gauges, piping
b. Hangers, supports, insulation, and identification.
c. Access panel
d. HVAC circulation pumps.
e. Insulation
f. Seismic bracing
j. Piping
k. Heat tracing
m. HVAC equipments

1.33 CROSS AND INTERCONNECTIONS

A. No HVAC equipment, device or piping shall be installed which will provide a cross or interconnection between a distributing supply or return system.

1.34 CORE DRILLING

A. This subcontractor shall perform all core drilling required for the proper installation of the HVAC system. Locate all required openings and prior to coring coordinate the opening with the General Contractor. All other openings are by the General Contractor.

B. All core drilling locations must be approved by the Owner.

1.35 COMMISSIONING OF HVAC SYSTEMS

A. Commissioning of systems to be provided by authorized commissioning agent and not this sub-contractor. Commissioning of systems to be as directed by owner. Commissioning of selected

systems shall be provided by and secured by owner. Refer to Section 18000 of General Specifications.

B. The HVAC Contractor shall provide 3 days (8 hrs) per each system to assist the commissioning agent in their procedures.
1.Refer to Commissioning Section 18000 in General Specification.

2 PART 2-PRODUCTS

2.1 MATERIALS

A. All materials, except as otherwise specified, shall be new, of current production, first quality and the best of each class specified.

B. Required materials not covered by detailed specifications shall be of a suitable class, grade, quality and type and shall be subject to the approval of the Architect. Where two or more units of the same class of equipment are required, these units shall be the products of a single manufacturer.

C. All equipment shall be installed and constructed to operate safely, as designed, without leakage, undue wear, noise, vibration or corrosion.

D. All products used in this project installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's Representative in writing. Spare parts shall be available for at least five years after completion of this contract.

2.2 ELECTRIC MOTORS AND RELAYS

A. Design, type and ratings of electric motors shall comply with the National Electrical Code, NEMA and Underwriter's Laboratory.

B. Unless otherwise noted or required for special applications, motors shall be open drip-proof with sealed ball bearings.

C. All electric motors shall be of the voltage, type and frame as specified in the electrical portion of the specifications.

2.3 ACROSS-THE-LINE STARTERS

A. All motor starters shall be across-the-line start with magnetic contactors and thermal overloads properly sized for the motor nameplate data.

B. All motor starters shall be furnished with a Hand-Off-Auto (HOA) switch mounted on the cover of the enclosure.

C. All motor starters shall be furnished with a fused 120 volt control power transformer rated at a minimum of 2 amps.

D. All motor starters shall be furnished mounted in a NEMA 1 enclosure suitable for the mounting location.

E. All motor starters shall be provided with magnetic contactors having one normally open and one normally closed auxiliary contactor

F.Motor starter shall be furnished by HVAC contractor and installed by Electrical contractor.

2.4 SEISMIC BRACING

A. The HVAC Subcontractor shall provide all necessary design and materials for seismic restraint and protection of piping, Duct work and devices against damage where subject to earthquakes as required for the entire HVAC system within the building. All isolation and seismic devices shall be the product of a single manufacturer. Products of other manufacturers are acceptable provided their systems strictly comply with this section of the specifications. Provide isolation materials and seismic restraints complete and as manufactured by Mason Industries, Tolco or approved equal.

The work under this section shall include the design, furnishing and installation of all restraint devices and systems as may be required for the HVAC system including, but not necessarily limited to, the following:

1. All HVAC equipment and devices such as Roof top units, Boilers, pumps, air handlers, VAV Boxes, tanks, etc.
2. All HVAC system piping as required.
3. All HVAC system ducting as required.
3. Piping and duct penetrations through floors and walls.
4. Sleeves with clearances around the outside, as recommended.
5. Equipment isolation bases.
6. Piping and duct flexible connectors.
7. Seismic restraints for isolated equipment.
8. Seismic restraints for non-isolated equipment.
9. Certification of seismic restraint designs.

B. Submit ten (7) copies of descriptive data for all products and materials, including the following:

1. Catalog cuts and data sheets for the specific isolators, restraints and all other items to be utilized.
2. Details of methods of sleeving, HVAC, smokeproofing and isolation for pipes and ducts penetrating walls and slabs.
3. Specific details of seismic restraints and anchors, including number, size and locations for each piece of equipment.
4. Calculations to support seismic restraint designs.
5. All calculations, details and other submittal materials shall be sealed and signed by a structural or civil engineer registered in the state and qualified to perform seismic design calculations.
6. A seismic design liability insurance certificate that must accompany all submittals.

C. Code and standards requirements shall include, but not be limited to:

1. Applicable IBC with any additional State or Local requirements.
2. All State and Local codes.

C.Manufacturers working in this section must provide a seismic design liability insurance certificate and certify their ability to provide engineering and design as required by this section. This certificate shall be submitted to the Architect for review prior to any submittals.

2.5 HANGERS AND SUPPORTS

A. Pipe hanger or stanchion support assemblies shall include turnbuckles or other means of vertical adjustment.

B. Trapeze hangers may be used in lieu of separate hangers for closely spaced, parallel lines. Pipe hanger components shall be as per MSS SP-58.

C. Hangers shall have steel rods with two nuts and shall be suspended from suitable beam clamps or concrete inserts. Rod sizes shall be as recommended by the hanger manufacturer and at least the following:

1. Pipe to 2" .....3/8" diameter
2. 2½" - 3".....1/2" diameter
3. 4- 5" .....5/8" diameter

D. Maximum hanger or stanchion support spacing for copper or steel pipe shall be as follows:

PIPE SIZE	MAX SPACING	PIPE SIZE	MAX SPACING	PIPE SIZE	MAX SPACING
3/4” or less	5 feet	2 ½"	9 feet	6"	14 feet
1”	6 feet	3"	10 feet	8"	16 feet
1¼"	7 feet	3 ½"	11 feet	10"	18 feet
1½"	8 feet	4"	12 feet	12"	19 feet
2”	8 feet	5"	13 feet	14"	25 feet

E. Hangers or stanchion supports for copper tubing shall be copper plated where they contact the copper tubing.

F.Hangers or stanchion supports for insulated pipe shall have insulation shields.

G. All rigid piping attached to the building and serving equipment subject to vibration shall be hung or supported on vibration isolators for the first 20 feet.

H. Vertical rises shall be supported from stands at the bottom of the rise or hangers at the top of the rise as shown on the drawings per the Contractor's option.

2.6 ANCHORS

H. Anchor points as shown on the drawings or as required shall be located and constructed to permit the piping system to take up its expansion and contraction freely in opposite directions away from the anchored points.

1. Make proper provision for expansion and contraction in all parts of hot water and steam piping systems wherever possible by means of pipe bends, pipe offsets, swing connections or changes in direction of piping.

I. Where piping network cannot be employed to absorb expansion and contraction in the piping systems, provide expansion joint compensators. Use of expansion compensators in non-accessible locations shall not be permitted.

1. All mains and risers having expansion offsets or compensators shall be securely anchored to the building construction in such a manner as to throw all expansion towards the offsets or joints. The HVAC Contractor shall be responsible for any additional structural members that may be required for proper installation of hangers, anchors, guides and supports.

2.7 VIBRATION ISOLATORS

A. Double deflection neoprene mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Boltholes shall be provided for these areas where bolting is required.

B. Spring type isolators shall be free standing and laterally stable without any housing and complete with ½" neoprene acoustical friction pads between the baseboard and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 80% of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections, compressed spring height and solid spring height.

C. Vibration hangers for piping and mechanical equipment shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bussing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through an arc of 30° before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing showing the 30° swing capability. For locations requiring precise elevation during installation the hanger shall be precompressed to the rated deflection and the released after completion of the installation.

D. Vibration hangers for duct systems shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through an arc of 30° before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing showing the 30° swing capability.

E. Horizontal thrust restraints shall be provided on equipment subject to excessive displacement. The horizontal thrust restraint shall consist of a spring element in series with a neoprene pad. The spring element shall be contained within a steel frame and designed so that it can be preset for thrust and adjusted to allow for a maximum of ¼" movement when the equipment starts or stops. The assembly shall be furnished with one rod and angle brackets for attachment to the equipment and the ductwork. Horizontal thrust restraints shall be attached at the centerline of the thrust and symmetrically on each side of

the unit.

2.8 PIPING INSULATION MATERIALS

A. Insulation for pipe shall be glass fiber with a K factor of .24 at 100° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket with a factory applied double pressure sensitive adhesive sealing system.

B. Insulation for concealed fittings and valves shall be glass fiber blanket with a K factor of .24 at 75° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket.

C. Exposed fittings, valves and flanges shall be insulated with molded fitting covers or fabricated segments of pipe insulation.

D. Insulation, jacket and sealant shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less per UL 723.

E. Insulation shall be Owens-Corning Fiberglass ASJ/SSL-II or approved equal.

F. All refrigerant piping (suction and liquid lines) shall be insulated with flexible foamed plastic, minimum 5.0 lb. Per cubic foot density, thermal conductivity not greater the 0.28 Btu-in/sq ft/°F/hour at mean temperature difference of 75°F.

G. All outdoor exposed refrigerant piping shall be painted with two coats of WB Armaflex finish. Prior to applying the finish, the insulation shall be wiped clean with denatured alcohol. The finish shall not be tinted. All seams shall be located on the lower half of the pipe.

H. Insulation thickness shall be as follows:

SYSTEM	PIPE SIZE	THICKNESS
Heating/Cooling Water	½"-1½"	1"
Heating/Cooling Water	2"-4"	1½"
Heating/Cooling Water	> 4"	2"
Make-up Water	all	1"
Refrigerant	all	1½"

2.9 HYDRONIC PIPING

A. Hot water system piping shall be as follows:

	2” and SMALLER	2½" and LARGER
Construction	Solder joint construction with screwed or flanged connections to valves and equipment as required.	Grooved end connection with flanged connections to equipment as required.
Pipe	Type "L" hard temper copper tubing	Carbon steel, Schedule 40 to 8"; ASTM A-120 up to and including 4" ASTM A-53 grade A B for pipe 5" and larger.
Fittings	Cast bronze or cast or wrought copper	Carbon Steel schedule to match pipe.

	fittings with 95-5 solder.	
Couplings	Same as fittings	Same as fittings.
Unions	Same as fittings	

2.10 VALVES

A. All valves shall be first quality of an approved manufacturer, shall be installed with the proper clearances and shall be tight at the specified pressures.

1. Valves shall be of minimum working pressure and materials as fittings specified for the service, however, in no case shall valves be designed for less than 125 PSI working pressure.
2. Where a specific manufacturer, brand and/or figure number is specified, an equivalent figure from an approved manufacturer shall be acceptable.
3. For shut off service the Contractor shall have the option of using gate valves, butterfly valves or ball valves with full open ID.
4. For throttling or modulating service the Contractor shall use a butterfly valve or another type of valve if a specific valve is specified on the drawings.

B. Butterfly Valves

1. Butterfly valves shall be of the flangeless type and may be lug or wafer style if not specified on the drawings.
2. Butterfly valves shall be rated 200 PSI bi-directional, differential pressure with a 200 PSI dead end service rating.
3. Butterfly valves shall have bodies of shock resistant ductile iron and shall have extended necks for 2" of insulation.
4. Butterfly valves shall have no exposed fasteners in the waterway to pin the disc to the stem.
5. Liners shall be molded in and supported by the valve body at the flange seals.
6. Top and bottom stem bushings of dissimilar material are required with a positive retention mechanism
7. Butterfly valves shall be NIBCO figure W/LD 2000.
8. Butterfly valves larger than 4" shall be provided with gear operators.

C. Check Valves

1. Check valves shall be bronze 2." and smaller; Cast iron or cast steel with bronze trim for 3" and larger.
2. All check valves shall have removable caps and regrindable disc and seat ring.
3. Bronze check valves shall be rated 125 PSI SWP, 200 PSI WOG as NIBCO figure T-413 or S-413.
4. Iron Check valves shall be 125 PSI SWP, 200 PSI WOG as NIBCO figure F-918.

D. Globe Valves

1. Globe valves shall be bronze 2½" and smaller; Iron with iron trim for 3" and larger as NIBCO figure T-211 or S-211.
2. Bronze globe valves shall be rated 125 PSI SWP, 200 PSI WOG

3. Iron globe valves shall be OS&Y 125 PSI SWP, 200 PSI WOG as NIBCO figure F-718-N.
4. All globe valves shall be suitable for repacking under pressure.

E. Ball Valves.

1. Ball valves shall be bronze 2½" and smaller as Pittsburgh Brass Manufacturing (PBM) Code B and shall be rated for 200 PSI @ 250^{O}F.
2. Ball valves shall be provided with self draining balls to drain to downstream side.

F.Gate

G. Valve Handles and Operators.

1. Butterfly valves shall be provided with locking lever type hand operators notched to allow incremental positioning and with a positional lock to function as a memory stop. The lock shall be lockable via a padlock.
2. Gate valves shall be provided with handwheels.

H. VALVE TAGS

1. Valve Tags shall be a minimum of 2" in diameter, constructed of No. 18 gauge aluminum with stamped numbers and letters filled in with black paint, fastened to valve by heavy aluminum or brass hooks or chain and shall be a different pattern than those used by plumbing and fire protection

2.11 STRAINERS

A. Strainers shall be installed at the inlet connections to each pump, make-up water connection, water regulating valve and vent, to protect the functionality of all automatic apparatus.

1. Strainers shall be Mueller or approved equal.

B. Strainers shall be line size, Y-pattern and set in the horizontal or vertical downward orientation.

1. Strainers shall be bronze rated 225 PSI at 150.F, 2½" smaller. Bronze strainers shall be Mueller model 351.
2. Cast iron rated ANSI 125# for 3" and larger. Cast iron strainers shall be Mueller model 751.

C. Provide valved dirt blow off connections for each strainer with a valve located 6" to 1'-0" below strainer. Nipples and valves for dirt blow off connections to be full size of strainer blow off tapping. Valves shall have hose bibb connections angled down and shall be provided with a chained cap.

2.12 PIPE EXPANSION COMPENSATION DEVICES

A. Piping shall be installed with expansion loops, expansion couplings, offsets or elbows to accommodate expansion and/or contraction. Where such accommodations are not possible

or at the Contractor's option an expansion compensation device may be used.

2.13 SLEEVES

A. Provide Schedule 40 galvanized steel pipe sleeves for each pipe passing through a wall, floor, partition or roof.

2.14 PRESSURE GAUGES

A. Pressure gauges shall be 4½" diameter dial, stainless steel case and ring phosphor bronze bourdon type, 1 percent full scale accuracy with bottom connection. Each gauge shall be provided with an isolation cock and pulsation snubber.

1. Gauges at pump inlets and outlets shall have a red setpoint indicator.
2. Gauge ranges shall be 0-100 PSIG or 10-50 PSIG as appropriate for the system and location.

2.15 THERMOMETERS

A. Thermometers shall be industrial type with 9 inch scale, red perma-colored liquid, black scale divisions on white background, union hub, separable brass well and adjustable swivel base. Extension wells shall be provided on insulated lines.

1. Thermometer ranges shall be 50-250°F for the heating water system and 0-100ºF for the cooling water system.

2.16 FLEXIBLE CONNECTORS

A. Flexible connectors shall be as manufactured by Mason Industries Model MFTNC twin sphere neoprene connectors.

2.17 RELIEF VALVES

A. Relief valves shall be constructed with iron bodies and all bronze working parts. They shall be set for the pressures indicated on the drawings or as required by the system and built to comply with the requirements of ASME.

2.18 AUTOMATIC AIR ELIMINATION ASSEMBLY

A. The air separator shall be a tangential inlet and outlet type separator. The air shall be vented to atmosphere via an automatic float activated vent valve located in the top of the air separator. The air elimination system shall be constructed of cast iron or welded steel; constructed and tested in accordance with Section VIII of the ASME code for a working pressure of 150 psi.

1. Vent valves shall be piped with a 3/8” copper tubing to the nearest floor drain.

2.19 PURGE/BALANCE VALVES

A. Purge valves shall be all bronze construction with a ½" drain tapping. Purge valves shall be installed as shown on the drawings and as required to completely purge all branches of the piping systems.

2.20 DUCT INSULATION MATERIALS - DUCT WRAP

A. Insulation for ducts and fittings shall be glass fiber with a K factor of .25 at 75° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket with a 2" stapling flange.

1. Insulation, jacket and sealant shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less per UL 723.
2. Insulation shall be Owens-Corning Fiberglass Type 150 or approved equal.

2.21 FILTERS

A. Unless otherwise noted filters in fan VAV and HRVs shall be 2” 30-30 filters.

B. See RTU Filters.

2.22 RECTANGULAR DUCTS AND FITTING

A. All ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.
B. All ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

2.23 ROUND DUCTS

A. All ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

2.24 FLEXIBLE DUCTS AND CONNECTORS

A. All flexible ducts shall be made from aluminum sheet, spiral wound into a corrugated tube. No adhesives shall be used in it's construction. Spiral wound flexible ducts will not be acceptable.

B. All flexible ducts must conform to NFPA 90A requirements and be tested in accordance with UL-181 and bear a UL label and be installed in accordance with their listing by UL.

C. All connections between vibrating or rotating equipment and ductwork shall be made with a flexible connection consisting of a heavy fiber glass fabric, double coated with neoprene and shall be fireproof conforming to NFPA 90A, waterproof and airtight. The flexible connection shall be a minimum of 6" long and held in place with heavy metal bands.

2.25 VOLUME DAMPERS

A. Furnish and install, where indicated on the drawings or where required for balancing, air splitter dampers, butterfly dampers, or opposed blade dampers with indicating and locking quadrants or push rods and pillow blocks.

B. Opposed blade dampers shall be manually operated multi-blade type with sleeve bearings, galvanized steel interlocking blades and a galvanized steel frame. In ducts over 19" in depth and 12" in height, use multiple opposed blade type, gang operated dampers with a maximum blade width of 8". Fabricate the damper blades of 10 gauge steel with hemmed edges, and a maximum length of 48". Damper operating rods shall be the full blade length and shall extend through the duct to externally mounted bearing plates. On insulated ductwork, bearing plates shall be flush with insulation finish and fastened to the duct. The operating lever shall be of the indicating type with locking quadrant. Splitter dampers shall be sufficiently long to extend the full width of the branch duct to which they are attached. Where necessary they shall curve to scoop branch duct air out of the main duct airstream. The dampers shall be constructed in accordance with the latest SMACNA standards and shall be at least two gauges heavier than the ducts in which they are installed.

2.26 ACCESS PANELS

A. Hinged access panels shall be provided at locations of volume dampers, and elsewhere as required to service the duct systems. Access doors shall be fully gasketed for air tight seal at the rated working pressures of the systems in which they are installed. Access doors shall be adequately sized for their intended purpose and equipped with a minimum of two sash locks. Access doors in insulated ducts shall be double wall and insulated.

2.27 REGISTERS, GRILLES AND DIFFUSERS

A. The types, sizes and airflow patterns of the registers, grilles and diffusers as specified and as shown on the plans have been selected to accomplish the intent and purpose of the system. Any substitutions proposed for items scheduled, shown or specified must provide the same air flow patterns, at the same air volumes and must have the same acoustical characteristics as the specified elements.

B. All interiors of all ducts in back of all registers, grilles and diffusers shall be painted with one coat of flat black nonflammable paint.

C. Duct connections to supply devices shall be made inside the collars, if any, and, duct connections to return or exhaust devices shall be made outside the collars, if any.

D. All registers, grilles and diffusers shall have a baked enamel, white, semi-gloss finish.

E. Square and rectangular diffusers shall have removable cores with opposed blade dampers, gasketed borders and concealed fastenings.

F. Frame types of diffusers shall be as appropriate for the type of ceiling in which they are to be installed.

G. Supply, return and exhaust air registers shall have opposed blade dampers and gasketed borders.

2.28 THERMOSTATS

A. Thermostats shall be provided where shown on the drawing.

2.29 INLINE PUMPS

A. Furnish and install pumps with capacities as shown on plans.

B. The pumps shall be of the horizontal, oil-lubricated type, suitable for 125 pounds working pressure

C. The pumps shall have a ground and polished steel shaft with a hardened integral thrust collar. The shaft shall be supported by two horizontal sleeve bearings designed to circulate oil.

D. The pumps are to be equipped with a mechanical seal with carbon seal face rotating against a ceramic seat. The motor shall be non-overloading at any point on pump curve.

E. The motor shall be of the drip-proof, sleeve-bearing, quiet-operating, rubber mounted construction. Motors shall have built-in thermal overload protectors.

2.30 FIRE STOPPING

A. Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and fired experience.

B. Provide all required accessories including, but are not limited to: Slag-/rock-wool-fire insulation, Fire-rated form board, Temporary forming materials, Substrate primers, Collars and Steel sleeves

2.31 SHEET METAL WORK

A. All supply, return and exhaust air ductwork of all types shall be constructed of galvanized sheet metal based on the "Pressure Class" indicated in the "Minimum SMACNA Construction Standards" table found hereinafter. Note: In addition, the construction pressure class shall be at least 2" more (negative or positive) than the scheduled fan pressure.

B. In addition to sheet metal ductwork provided under this Contract, furnish and/or install accessories and devices furnished by others, including but not limited to smoke detectors. Provide and install miscellaneous sheet metal work including safing, mixing baffles, and blank off panels at unused louver areas.

C. All duct systems specified to be installed under this Contract, shall conform to the drawings, specifications, Standards, details and recommendations of the latest Edition of SMACNA "HVAC Duct Construction Standards - Metal and Flexible"; and "Round and Industrial Duct Construction Standards" (hereinafter referred to as Duct Manual).

D. Provide volume dampers in all branch takeoffs and in all main branches and ducts of all ductwork systems (supply, return and exhaust) for properly regulating and balancing airflow to all terminal outlets, for all duct sizes, whether shown on the drawings or not. Volume dampers installed in ductwork that is to be externally insulated shall have extended activator/handle rods such that adjustment of the damper handle will not disturb the insulation.

E. Fire Dampers shall be provided as shown on the drawings and wherever Architectural drawings indicate fire and rated partitions.. All dampers shall meet the requirements of NFPA 90A and further shall be tested, rated and labeled in accordance with UL 555, latest edition.

2.32 AIR TERMINAL BOXES (VAV)

Fan Powered Terminals (Constant Volume)

1. Furnish and install TITUS Model DTQP series flow fan powered terminals of the sizes and capacities shown on the plans. Space limitations shall be reviewed carefully to ensure that all terminals will fit the available space.
2. Terminals should be certified under the ARI Standard 880 Certification Program and carry the ARI Seal. Non-certified terminals may be submitted after testing at an independent testing laboratory under conditions selected by the engineer in full compliance with ARI Standard 880. These tests must be witnessed by the engineering consultant with all costs to be borne by the terminal manufacturer. Testing does not ensure acceptance.
3. The terminal shall be designed, built, and tested as a single unit including motor and fan assembly, primary air damper assembly,water heating coils, and accessories as shipped. Unit shall ship as a complete assembly requiring no field assembly (including accessories). All electrical components shall be UL listed and installed in accordance with the UL Standard 1995. Electrical connection shall be single point. All electrical components, including low voltage controls, shall be mounted in sheet metal control enclosures. The entire terminal shall be ETL listed as a complete assembly.
4. The terminal casing shall be minimum 20-gauge galvanized steel, internally lined with engineered polymer foam insulation, which complies to UL181 and NFPA 90A. Insulation shall be 1½ pound density, closed cell foam. Exposed fiberglass is not acceptable. The insulation shall be mechanically fastened to the unit casing. The casing shall be designed for hanging by sheet metal brackets.
5. The terminal casing shall have top and bottom access panels, which allows removal of fan assembly and servicing of terminal without disturbing duct connections.
6. ECM Motor
   a. Fan motor assembly shall be forward curved centrifugal fan with a direct drive motor. Motors shall be General Electric ECM variable-speed dc brushless motors specifically designed for use with single phase, 277 volt, 60 hertz electrical input. Motor shall be complete and operated by a single phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commutate the stator. All motors shall be designed for synchronous rotation. Rotor shall be permanent magnet type with near zero rotor losses. Motor

shall have built-in soft start and soft speed change ramps. Motor shall be able to be mounted with shaft in horizontal or vertical orientation. Motor shall be permanently lubricated with ball bearings. Motor shall be directly coupled to the blower. Motor shall maintain a minimum of 70 percent efficiency over its entire operating range. Provide a motor that is designed to overcome reverse rotation and not affect life expectancy.

b. The terminal unit manufacturer shall provide a factory installed PWM controller for either manual or DDC controlled fan cfm adjustment. The manual PWM controller shall be field adjustable with a standard screwdriver. The remote PWM controller shall be capable of receiving a 0-10 Vdc signal from the DDC controller (provided by the controls contractor) to control the fan cfm. When the manual PWM controller is used, the factory shall preset the fan cfms as shown on the schedule.
c. The primary air damper assembly shall be heavy gauge steel with shaft rotating in Delrin self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking, and a synthetic seal to limit close-off leakage to the maximum values shown in the following table Provide an AeroCross™ four point, center-averaging differential pressure airflow sensor. A sensor that delivers the differential pressure signal from one end of the sensor is not acceptable. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.
d. The sound levels shall not exceed the octave band sound power levels indicated in the table above. Sound performance shall be ARI certified. If NC is provided instead of octave band sound power data, the radiated and discharge path attenuation function for the specified NC shall be based upon factors found in ARI Standard 885-98, Appendix E. No additional attenuation factors shall be deducted from the sound power.

7. Hot Water Heating Coils
   a. Hot water heating coils shall be enclosed in a minimum 20-gauge galvanized steel casing, with flanged construction for attachment to metal ductwork. Coils shall be factory installed on the terminal. Fins shall be rippled and corrugated heavy gauge aluminum, mechanically bonded to tubes. Tubes shall be copper with minimum wall thickness of 0.016 inch, with male solder header connections. Coils shall be leak tested to 300 psi, with minimum burst pressure of 1800 psi at ambient temperature. Number of coil rows and circuits shall be selected to provide performance as required per the plans. Coil performance data shall be based on tests run in accordance with ARI Standard 410.

A. ESV Basic Unit

1. Furnish and install TITUS Model DESV single duct, variable air volume terminals of the sizes and capacities shown in the plans.
2. Terminals shall be certified under the ARI Standard 880 Certification Program and carry the ARI Seal. Noncertified terminals may be submitted after testing at an independent testing laboratory under conditions selected by the engineering consultant in full compliance with ARI Standard 880. These tests must be witnessed by the engineering consultant with all costs to be borne by the terminal manufacturer. Testing does not ensure acceptance.
3. The terminal casing shall be minimum 22-gauge galvanized steel, internally lined with engineered polymer foam insulation which complies to UL181 and NFPA 90A. Insulation shall be 1½ pound density, closed cell foam. Exposed fiberglass is not acceptable. The

insulation shall be mechanically fastened to the unit casing. The casing shall be constructed to hold leakage to the maximum values shown in the Casing Leakage table.

4. The damper shall be heavy gauge steel with shaft rotating in Delrin® self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking and a synthetic seal to limit close-off leakage to the maximum values shown in the Damper Leakage table.
5. Actuators shall be capable of supplying at least 35-inch lbs. of torque to the damper shaft and shall be mounted externally for service access. Terminals with internal actuator mounting or linkage connection must include gasketed access panel, removable without disturbing ductwork. Casing with access panel shall be constructed to hold leakage to the maximum values shown in the Casing Leakage table.
6. At an inlet velocity of 2000 fpm, the minumum static pressure required to operate any terminal size shall not exceed 0.13-inch wg for the basic terminal.
7. Sound ratings for the terminal shall not exceed 30 NC at 1.0” static pressure. Sound performance shall be ARI certified.

2.33 WATER PUMPS

A. Pumps shall be in line, centrifugal type as indicated with flexible coupling connections of pump to motor, and coupling guard as manufactured by Bell and Gossett, Taco or Thrush. Pumps shall be complete with mechanical seals, standard bronze fittings, and 1750 RMP motors, magnetic starters with "Hand-Off-Auto" selector switches and pilot lights in covers. Pump capacities shall be as indicated on the drawings. All pumps shall be nonoverloading at any point on pump curve.

2.34 FLEXIBLE CONNECTORS

A. Neoprene Flexible Connectors:

1. Furnish and install where indicated on the drawings and at the piping connections to all pumps, chillers, and any other equipment that vibrates, flexible connectors. They shall be constructed of nylon reinforced neoprene with 150 lb flanges. Units shall be rated at 215 psi operating pressure at 240°F.
2. The units shall have a minimum axial compression of 2", transverse movement of 1 1/2", and angular movement of 30°.
3. Connectors shall be Model TF as manufactured by C-Flex or equal equipment by Mason Industries or Armstrong Pump Company.

2.35 UNIT HEATERS

A. Propeller type, arranged for horizontal discharge, complete with suitable efficient air deflectors, hot water coil, direct driven motor and guard. Unit shall be manufactured by Airtherm, Sterling or Modine with capacities and sizes as indicated on the drawings. Unit heaters shall be provided with disconnect switches, mounted on heater casing.

B. Cabinet, centrifugal, multiple type, with arrangements as indicated on the drawings, complete with direct driven motor with intergral overload protection, nonferrous hot

water heating coils, and cabinets with colors as selected by Architect. Units shall be as manufactured by Airtherm, Modine or Sterling.

2.36 WATER TREATMENT

A. The HVAC Contractor shall furnish and install where shown on the drawings and where specified hereinafter, the necessary apparatus to provide water treatment and service as furnished by Betz Laboratories, Inc., Barnstead Still and Sterilizer Company, Barclay Chemical, Inc., or as approved.

B. A contract satisfactory in form and substance to the Owner shall be executed between the HVAC Contractor and the Water Treatment Company to furnish supervisory service to assure the use of the proper chemical treatment to and for the systems of a period of one year from the date of the initial treatment thereof.

C. The contract shall be assigned by the HVAC Subcontractor to the Owner on the date that the building is accepted by the Owner so that water treatment will continue uninterrupted during the one year life of the contract. The water treatment company shall perform the following through its agents:
   1. Supervise the initial introduction of water treatment.
   2. Provide service calls by its agents at a frequency of not less than once per thirty (30) days thereafter.
   3. Furnish all required chemicals for proper treatment of all systems hereinafter described together with all necessary testing equipment and reagents for field analysis of the water during the aforementioned one year period.

D. HVAC Subcontractor shall assume responsibility for the field testing and control, regular addition of chemical treatment in whatever amounts are necessary on each of the systems hereinafter described until the date of acceptance of the building by the Owner.

E. Before actual execution of the above contract, a copy of the proposed contract form shall be submitted to the Architect for approval.

F. Hot Water Systems:

   1. Liquid chemical bypass type feeders of approximately 5-gallon capacity, complete with valves and fittings shall be connected across the water pumps.
   2. The water circuits shall be treated with sufficient amounts of the proper chemicals to give a starting concentration of 1,000 ppm of sodium chromate, the concentration not to fall below 550 ppm during operation of any of these systems.

2.37 ERV UNIT

A. Casings: Panels shall be of 18 gauge steel, cleaned, phosphatized and finished inside and out with baked enamel finish. Unit shall be completely insulated with 1" fireproof, permanent, odorless glass fiber material with knockouts provided on both sides of unit for utility and piping connections.

B. Fans shall be double width, double inlet, forward curved, multi-blade fans, statically and dynamically balanced with fan assemblies rotatable from top to rear. Variable pitch drive shall be provided.

C. Casings and all accessories, with the exception of coils, shall be given a protective enamel paint finish. Fans and scroll shall be coated with corrosion resistant paint.

D. Unit shall be complete with gas-fired furnace,. Automatic outside air damper and filters .

E. ERV shall be complete with remote control unit.

F. Unit shall be provided with variable drive sized with 50% safety over motor nameplate and shall be complete with magnetic starter with "H-O-A" in cover.

2.38 MOTORS

A. All motors shall be premium efficiency type.

B. Motors 1 HP and greater shall be 208/230 Volt/3 Phase/60 Hertz.

C. All motors shall be rated for inverter duty, and stamped as such.

D. All motors shall have Class F insulation or higher temperatures

E. Motors shall be manufactured by Toshiba, General Electric Co., Baldor or Approved Equal.

2.39 ROOF EXHAUST FAN

A. Furnish and install fans with capacities as shown on plans.

B. Roof exhaust fans shall be centrifugal type as scheduled.

C. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances.

D. Wheels shall be statically and dynamically balanced.

E. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. Windbands shall have a rolled bead for added strength and shall be joined to curbcaps with a leakproof, continuously welded seam.

F.Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted on vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.

G. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.

H. Motor pulleys shall be adjustable for final system balancing. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring.

2.40 HYDRONIC PUMPS AND ACCESSORIES

A. Acceptable manufactures: Bell and Gossett. Taco, Armstrong or approved equal.

B. Construction shall permit complete servicing without breaking pipe or motor connections.

C. Pumps to operate at 1750 rpm unless scheduled or specified otherwise.

D. Provide guards around shafts and couplings in accordance with OSHA and ANSI recommendations.

E. All parts shall be suitable for Variable frequency drives; including but not limited to Motor, Pump, all pump components, coupling, and base.

F. Design and performance requirements: Pump curve shall rise continuously from maximum flow to cut off. Shut-off head shall be approximately 20 percent greater than design head, unless Pump brake horsepower not to exceed motor horsepower rating over entire operating range (from shut-off to run-out). Motor shall not operate in service factor. Pumps shall operate within the preferred operation region as defined by the Hydraulics Institute. Select pump for operation at or near peak efficiency. Cavitation-free at all points on curve. Impeller diameter shall not exceed 90 percent of the maximum cutwater diameter. Vibration levels of pump shall be within the vibration limits established by hydraulic institute.

2.41 EXPANSION AND COMPRESSIONS TANKS

A. Tanks shall be the pressurized captive air bladder type, with replaceable elastomeric bladder suitable for a maximum operating temperature of 240°F.

B. Tanks shall be constructed and certified to ASME Section VIII - Pressure rating of 150 psig, Temperature of 240°F

C. Provided with integral steel base ring for vertical mounting, charging valve enclosure, remote air connector coupling, system connection and lifting rings.

D. Tanks shall be provided with factory applied rustproof coat of paint to the exterior of tanks.

E. AIR SEPARATORS - Provide tangential type air separator with flanged inlet and outlet connections and bottom blow down drain connection with valve.

2.42 CHEMICAL WATER TREATMENT

A. The HVAC Contractor shall engage the services of a nationally recognized water treatment manufacturer or local representative of such manufacturer to provide a complete water treatment service, designed to minimize corrosion and scale formation in all water systems. This service shall include providing the equipment, controls, chemical feed pumps, bypass feeders, all chemicals and consulting analysis service for the initial clean out and start-up period of each system.

2.43 TESTING, ADJUSTING, & BALANCING

A. The HVAC Contractor shall procure the services of an independent Balancing and Testing Contractor who specializes in the balancing and testing of heating, ventilating and air conditioning systems to balance and adjust, all moving equipment and air distribution and exhaust systems and test all water systems and equipment, as herein specified. All work by the Balancing Contractor shall be done under direct supervision of a qualified heating and ventilating Engineer employed by the Balancing Contractor.

2.44 ROOFTOP AIR HANDLING UNITS

A. General

1. Rooftop air handling units shall be as manufactured by York manufacturer Inc.V-Series
2. Units shall be manufactured by York or equal in an ISO 9001 certified facility. YORK's Millennium package units are convertible single packages with a common footprint cabinet and common roof curb for all 25 through 40 ton models. All units have independent refrigeration circuits and provide up to 4 stages of cooling. These packaged cooling/heating air conditioners are designed for outdoor installation and can be easily installed on a roof curb or slab. All Millennium units are self-contained and assembled on rigid full perimeter base rails with internal lifting lugs for overhead rigging. Every unit is completely charged, wired, piped, and tested at the factory to provide quick and easy field installation. Only utility and duct connections are required at the point of installation. The multi-stage gas fired heaters have aluminized steel tubular heat exchangers and spark to pilot ignition. They are available in natural gas with field conversion to propane.
3. Description: Supply Based on York Millennium packaged rooftop system in accordance with the capacities in the plans. Units shall be rated by the manufacturer at a minimum 10.5 EER according to ARI 360. Units shall be shipped in a single package, fully charged with R-410A refrigerant. The manufacturing facility shall be registered under ISO 9001 Quality Standards for Manufacturing. Units shall carry both ETL and CGA safety approval ratings. Tags and decals to aid in the service or indicate caution areas shall be provided. Installation and maintenance manuals shall be supplied with each unit. Units shall be capable of providing mechanical cooling down to 40°F (0°F with low ambient kit). Unit shall be capable of starting and running at 120°F. Unit electric and gas connections shall be either through the curb or the side of the unit.
4. Construction; The base rail shall be constructed of 12 gauge galvanized steel, extending the full perimeter of the unit. All components shall be supported from the base, and the base shall include integral lifting lugs. The unit base rail shall overhang the roof curb for water runoff and shall have a fabricated recess with a continuous flat surface to seat on the roof curb gasket, providing a positive, weather tight seal between the unit and the curb.
5. Casing; The unit cabinet shall be double wall construction to provide both maximum resistance to bacterial growth in the air stream and superior structural integrity. All sheet metal shall be G90 mill galvanized sheet metal, formed and reinforced to provide a rigid assembly. Sheet metal shall be cleaned in an alkaline and zinc phosphate bath, and the exterior surfaces shall be coated with a 1.5 mil powder paint, capable of withstanding 1000 salt spray hours in accordance with ASTM B-117. The unit shall be insulated with 1-1/2", 1 pound fiberglass insulation between the two

sheet metal skins. Insulation shall meet NFPA-90A regulations for smoke and flame spread ratings. The cabinet corner post and the intermediate side supports shall be 16 gauge steel. All access doors shall be 18 gauge on the exterior surfaces, and 20 gauge on the interior. Floor shall be 18 gauge, and 24 gauge. All serviceable sections shall have optional hinged access doors with latches on both sides of the unit. All access doors shall be constructed of 20 gauge steel on the outside, with 24 gauge on the inside. Each door shall seal against a rubber gasket to prevent air and water leakage. The roof shall be double wall, with 18 gauge on the external surface and 24 gauge on the interior. The roof shall be formed with a 45 degree drip lip overhanging the sidewalls to prevent precipitation drainage from streaming down the side of the unit. Roof sections shall be connected together via integral channels fastened with screws and sealed with rubber gasketing. Each fastened seam shall be further protected by a sheet metal channel covering the full length of the gasket surface, making a completely water tight seal.

6. Unit shall have the approval of one of the following agencies: Underwriters' Laboratories (UL), Electrical Testing Laboratories (ETL) or American Standards Association (ASA). The air handler shall bear an appropriate label certifying that the unit has been designed and manufactured in strict accordance with the UL1995 Standard for air handling equipment. If the manufacturer cannot provide an ETL/UL sticker on the air handler, it will be the sole responsibility of the contractor to arrange for local ETL or UL approval and labeling.
7. The Unit Electrical Panel(s) shall be built in strict accordance to NEC Standards and shall bear an appropriate label certifying compliance with UL Standard 508A.
8. The air handling equipment manufacturer shall provide single source responsibility for all components for the unit whether specifically manufactured by the unit manufacturer or obtained outside and installed in the equipment with the exception of consumable items such as filters, fan belts, etc., or as specifically warranted by the product manufacturer such as motors, VFD's, etc.
9. The attached schedules, tables and specifications are to be used as the selection criteria for the air handling equipment to include Air Flow Rates, External Static Pressures and Water Flow Rates. The following are to be equaled or bettered: Coil Face velocities and Filter Face Velocities. The following are to be met within 5% of specified values: internal air pressure drops, water pressure drops.
10. Additional Testing and Quality Assurance as explained in individual component / item sections in the following paragraphs of this specification.
11. Warranty:
    a. Unit manufacturer to warrant it's product to be free of defects in materials and workmanship under normal use when installed and operated in accordance with factory recommendations for a period of 18 months from date of shipment or 12 months after initial equipment start-up, which ever occurs first. Equipment found to be defective should be replaced or repaired to include all parts and labor. Component parts that require periodic replacement due to normal wear such as filters, fan belts, etc. are not covered by the warranty.

B. Submittals:

1. Submit shop drawings with product data.
2. Shop drawings shall indicate assembly weights, unit dimensions, required clearances, construction details, and field connection details.
3. Product data shall indicate dimensions, weights, capacities, ratings, fan performance to include fan curves, motor electrical characteristics to include motor technical data sheets, coil capacities to include performance printouts with pressure drops (water & air), vibration isolation, filter data sheets to include pressure drops, gauges and finishes.
4. Clearly identify any variations from contract documents.

5. Provide space on cover document for contractor and architect/engineer review stamps.
6. Revise & resubmit submittals as required.
7. Submit installation, start-up and Operation & Maintenance Data.
8. Include instructions for rigging, lifting, bearing lubrication, filter replacement, motor and drive replacement, and wiring diagram.
    a. Include a recommended spare parts list customized to each unit complete with appropriate tag #, serial and / or part numbers along with a description to clearly identify the items.

C. SUPPLY AIR FAN
1. Fans shall be centrifugal type, statically and dynamically balanced in the factory. Fan wheels shall be designed for continuous operation at the maximum rate of fan speed and motor HP. The fan and motor assembly shall be mounted on a common base to allow consistent belt tension with no relative motion between the fan and motor shafts. The entire assembly shall be isolated from the unit base with rubber isolators or optional 1" or 2" deflection springs. The fan discharge shall be connected to the cabinet through a reinforced neoprene flexible connection to eliminate vibration transmission from the fan to the unit casing. Fans shall be double-width, double-inlet with forward curved blades. Fan wheels shall be of Class I or Class II construction.

D. OPTIONAL
1. On variable air volume units without variable frequency drives, fans shall be provided with heavy gauge, corrosion resistant blades, with zinc-plated steel inter-locking operating mechanism. Both inlet vanes must operate from a single shaft and be synchronized for precise control.Units equipped with variable frequency drive on supply fan must be controlled by a duct static transducer providing a 2-10 VDC signal to the drive. Supply fan variable frequency drives shall have factory option of being equipped with a manual drive bypass.

E. BEARINGS AND DRIVES
1. Bearings shall be self-aligning pillow-block re-greasable ball bearings with an average life expectancy of 200,000 hours. Grease fittings shall be accessible through access doors. Fan motors shall be NEMA designed, Standard efficiency (option, Hi-efficiency) ball bearing type with electrical characteristics and horsepower as specified. Motors shall be 1750 RPM, open drip proof type. The motor shall be located within the unit on an adjustable, heavy steel base. All fan motor drives shall be selected for a minimum service factor of 1.2 and have fixed pitched sheaves.

F. AIR FILTERING SYSTEM
1. All filter holding frames shall be of heavy duty construction designed for industrial applications. All filters shall be either side accessible or front loading with access doors provided on both sides of the filter section. All filter media shall be Class II listed under UL Standard 900. Filter efficiencies shall be rated in accordance with ASHRAE Standard 52-76 2" Throwaway Filters with fiberglass media multiple shall be standard
2. Two inch pleated, throwaway filters with 30% efficiency. Rigid filters shall be high performance, expanded area, disposable type filters. Rigid filter sections shall be preceded by a 2” throwaway prefilter assembly. Filter efficiency shall be 95% (Option: 65%) based on ASHRAE Standard 52-76.

G. AIR INLET SYSTEM

1. Outside Air inlet openings shall be covered by a factory installed rain hood permanently attached to the cabinet to prevent windblown precipitation from entering the unit. The rain hoods on the front and back of the unit shall be rotated into the cabinet and secured for shipment so that upon installation they need only be rotated upwards and screwed into place. The outside air hood shall contain a removable and cleanable filter with an efficiency rating of 50% based on ASHRAE 52- 76. All damper assemblies shall be of low leak design. Damper blades shall be fabricated from a minimum of 16 gauge galvanized steel. Blade ends and edges shall be covered with vinyl seals. Damper shafts shall be fabricated from solid steel and mounted in the frame with bronze bearings. On all units not equipped with an economizer, an option shall be available for a manually adjustable outside air damper shall be capable of admitting 0-25% outside air.
2. An economizer shall have outdoor air and return air dampers that are interlocked and positioned by fully modulating, solid state damper actuators. The actuators shall be spring loaded so that the outside air damper will close when power to the unit is interrupted. The operation of the economizer shall be fully integrated into the cooling control system. The economizer shall be available for control via a dry bulb sensor (Optional: single or dual enthalpy sensors).
3. Building air exhaust shall be accomplished through barometric relief dampers installed in the return air plenum. The dampers will open relative to the building pressure. The opening pressure shall be adjustable.

H. Exhaust Air Fans
1. General - forward curved centrifugal fan(s) shall be installed in the return air plenum for positive power exhaust. Fans shall be on a common shaft, driven by a single motor. The fans, motors and drives shall be of the same quality and design as specified for the Supply Air Fan, except the fans shall be Class I. Fans shall be capable of exhausting up to 100% of the nominal CFM of the unit. Non-modulating Exhaust - Units with non-modulating power exhaust shall have a barometric relief damper to prevent outside air from entering in the off cycle. The fans shall cycle on and off with building pressure. Modulating Operation - The fans shall be capable of modulating the amount of air from 0% to 100% of nominal CFM. Modulation shall be through discharge dampers or variable frequency motor speed modulation. Dampers or VFD shall be controlled by static pressure in the conditioned space or return air duct.

I. HEATING SYSTEM
1. Gas-fired Heating Section One or more gas-fired heating modules shall be installed to provide the heating requirements per the schedule shown on the plans. The heat exchanger shall be of tubular design. Tubes shall be 2 ¼" OD and constructed of minimum 20 gauge, G160 aluminized steel (1.6 mil aluminum silicone alloy) for corrosion resistance (Optional: 409 Stainless Steel). Flue baffles shall be made of 430 stainless steel. Each gas-fired heat module shall have an induced draft combustion fan with energy efficient intermittent pilot spark ignition and redundant main gas valves with pressure regulator. Units with standing spark ignition shall not be acceptable. An induced draft fan shall be provided to maintain a positive flow of air through each tube, to expel the flue gas and to maintain a negative pressure within the heat exchanger relative to the conditioned space. Induced draft fans shall be direct-drive. One (1) high limit controller per heating module, with automatic reset to prevent the heat exchanger from operating at an excessive temperature will be installed. A centrifugal switch on the induced draft fan motor shaft must be provided to prevent ignition until sufficient

air flow is established through the heat exchanger. Secondary airflow safety shall be provided by rollout switch protection. The rollout switch shall discontinue furnace operation if the flue becomes restricted. Units shall ship with an external flue to be shipped in the unit and mounted on the job site. The flue shall discharge products of combustion above the unit, preventing recycling of corrosive combustion gases back through the heat exchanger. Gas heating sections shall be both ETL and CGA approved to both US and Canadian safety standards.

J. REFRIGERATION SYSTEM
   1. Units shall have four independent refrigerant circuits for maximum load-matching capability. Each refrigerant circuit shall be controlled with a balance-port thermal expansion valve for maximum control at low load conditions.
   2. Evaporator coils shall be direct expansion type with intertwined circuiting to assure complete coil face activity during part load operation. Coil tubes shall be 3/8" OD copper, internally enhanced tubes. Fins shall be enhanced aluminum mechanically expanded to bond with the copper tubes. Coil casing shall be fabricated from heavy gauge galvanized steel. All coils shall be pressure tested at a minimum of 450 PSIG. A coated steel or optional stainless steel drain pan shall be provided under the entire length and width of the evaporator coil, including all return bends. The main drain pan shall be sloped a total of ¼" per foot towards the drainage point. Main drain pan shall be easily cleanable in the field. The condensate drain opening shall be flush with the bottom of the drain pan to allow complete drainage. Coils in excess of 48" high shall have an intermediate drain pan, also fabricated of stainless steel extending the entire finned length of the coil to provide better water drainage. Drainage from the intermediate drain pan shall be to the primary drain pan. OPTIONAL: Evaporator coils shall be protected by the Technicoat 10-1 four coat process. Coils shall be dipped in a phenolic coating, which provides substantial resistance to corrosion of aluminum and copper.

K. Compressors
   1. Units shall have four industrial duty hermetic scroll compressors, independently piped and charged. Compressors shall have an enlarged liquid carrying capacity to withstand rugged operating conditions. Compressor frame shall be cast iron, with cast iron fixed and orbiting scrolls. Each compressor shall feature a solid state protection module, designed to protect the compressor from over temperature and overcurrent conditions. Each compressor shall include the following safety and convenience devices: replaceable suction screen, discharge line check valve, and oil sight glass. Compressors shall be vibration isolated from the unit, and installed in an easily accessible area of the unit.
   2. Condenser coils shall have 3/8" seamless copper tubes, arranged in staggered rows, mechanically expanded into aluminum fins. Coils shall be protected from hail damage with a V configuration, with individual flat coils rotated 30 from the vertical plane for each condensing circuit. Condensing coils shall have an integral subcooler for more efficient, stable operation. OPTIONAL: Condenser coils shall be protected by the Technicoat 10-1 four coat process. Coils shall be dipped in a phenolic coating, which provides substantial resistance to corrosion of aluminum and copper.
   3. Condenser fans shall be direct drive, propeller type, discharging vertically. Condenser fan motors shall be 3 phase, totally enclosed air over (TEAO) type, with built in thermal overload protection.

L. Refrigerant Piping

1. All interconnecting piping between refrigeration components shall be copper tubing with brazed joints. Each refrigerant circuit shall be equipped with liquid line filter drier, and moisture indicating sight glass. Each circuit shall also have both high and low pressure switches installed on either side of the compressor and include shrader depressors for replacement of the pressure switches without removing charge. All small diameter distributor tubing to the evaporator coil shall be protected by polyurethane sleeves over the length of the tubing to prevent the tubes from copper-to-copper contact during shipment or operation.

M. Hot Gas Bypass
1. Unit shall have hot gas bypass factory installed on the lead compressor.

2.45 CONTROLS

A. GENERAL DESCRIPTION
1. Equipment with Simplicity Elite™ as standard shall be factory run-tested through the control, after the test is complete; there will be no wires to re-connect. All control wiring points shall be tested and verified through communication. The control shall be UL or CSA recognized. The control shall be manufactured in a manufacturing facility that is certified to ISO 9001.

B. COMPRESSOR CONTROL
1. The control shall have a five-minute Anti-Short Cycle Delay to prevent excessive compressor cycling. The control shall have a three-minute minimum run time to insure that oil gets returned to the compressor each time it starts. The minimum runtime shall be programmable up to 10 minutes. The control shall monitor the High Pressure switch, the Low Pressure switch, and the Compressor Overloads separately for each refrigeration circuit. The control shall have a 30 second Low Pressure Switch bypass when it starts any compressor.
2. A hard compressor lockout shall occur if the control detects the same switch trip three times in a two-hour window, which starts when the first trip occurs. On the first and second trips, the control will turn the compressor off and wait five-minutes after the switch re-closes, before restarting the compressor.
3. The control shall be capable of operating both compressors and the economizer when there is a call for both stages of cooling. The control shall have a means of locking out mechanical compression below a programmable low ambient trip point. This must be done without adding extra components to the unit. The control shall have a means of locking out the mechanical compression when the economizer is operating in free cooling mode without additional components. The control shall have a means of starting the compressor before the indoor Fan comes on when operating with a Thermostat in the AUTO FAN mode.

C. FAN CONTROL
1. The control shall have fully adjustable Fan ON and Fan OFF delays for both Heating and Cooling settable at the control or via communication. The control's default Fan OFF delay for Cooling shall be 30 seconds to take advantage of the remaining capacity in the coil after the compressor has been turned off. The control shall lock on the Fan if the high temperature limit trips three times in one hour of operation. The control will have a software programmable Fan Mode Switch for Auto operation or Continuous operation. When the Fan is in the Continuous mode, it will run continuously during the

occupied schedule and in the Auto mode when in an unoccupied schedule. The control shall be capable of operating the fan without a G or fan signal from the thermostat.

D. EQUIPMENT CONTROL FEATURES

1. The control shall be capable of communicating on the Standard Open protocol, Modbus® RTU. The register data for the Modbus® must be publicly available and open. Monitoring Software shall be provided at no cost. The monitoring software shall have a flashing icon when any unit wired to the computer has an alarm. Clicking the flashing icon shall display the fault code and the details of the fault. The networking setup shall be completed by connecting a three-wire daisy chain cable to each unit, then powering all the units up and pushing a button on each control. There shall not be any dipswitches to configure the network address.
2. The control shall use a communication driver that is capable of having 64 nodes on the bus before a repeater is needed. The control shall use non-volatile memory to store the last five alarms. There shall be a single button to push to recall these last five alarms. The alarms shall be stored first in last out. The first flash code shall be the last alarm that occurred. There shall be a button press sequence to clear the alarms in non-volatile memory. The control shall have a button to reset compressor lockouts without powering the unit down.
3. The control shall have a button to clear compressor Anti-Short Cycle Delays. When this button is pressed it will only clear the Anti-Short Cycle Delays for one cycle only and not permanently. The control will be compatible with any BAS (Building Automation System). Any BAS shall be able to control the equipment when wired to the control's Thermostat Terminal Strip. The control shall have loading of at least 25 milliamps on all thermostat inputs for controllers and thermostats that use output TRIACs.
4. The control shall have a Smoke Detector Shutdown input on the board. The control shall be powered through this input, so when the Smoke Detector trips, the control will shut down the unit immediately. The control will have low voltage protection for the contactors and will not energize a contactor if the voltage is below 19.2 VAC, to insure contactor pull-in. If the control has a compressor contactor energized when the voltage drops, it shall not de-energize the contactor until the voltage drops below 16 VAC, which is the drop out voltage for most contactors. The control shall have a means of low ambient control without adding any additional components. The control shall have a means of cycling the compressor on for 10 minutes and off for 5 minutes to defrost the indoor coil when the outside ambient is below a low ambient switch point without adding additional components.
5. The control shall have a means of storing compressor run time. This data shall be available through communication. The control shall have the ability to clear this data when a compressor is replaced. The control shall have the ability to store a name of at least 26 characters in length. The control will leave the factory with the serial number of the equipment it is in, stored in non-volatile memory in the Name location. The control shall have the ability to store the model number of the equipment of at least 26 characters in length. The control will leave the factory with the model number of the equipment it is in, stored in non-volatile memory. The control shall have the ability to store the serial number of the equipment of at least 26 characters in length. The control will leave the factory with the serial number of the equipment it is in, stored in non-volatile memory.
6. The control shall not power the contactors through the thermostat wiring. Dropping voltage over the thermostat wiring causes chattering contactors when the contactors are powered in this manner. The control will operate and monitor up to 3 stages of heat

independently. The control shall monitor the Gas Heat operation in the heating mode. It shall monitor the gas valve when there is a call for heating. The control shall alarm when there is a call for heat and no gas valve voltage after 5 minutes. There will only be one control board for this series of units, for both CV and VAV operation.

E. COMFORT CONTROL FEATURES
1. The control will be installed and tested at the factory where the equipment is assembled.
2. The control will use a Wall Senor that has a means of overriding the unoccupied mode for a programmable amount of time.
3. The Unoccupied Override time will be programmed in minutes up to 4 hours.
4. The control will use a Wall Sensor that has a warmer/cooler dial so the occupants can offset the programmed setpoint by a programmed amount between 1 and 5 degrees
5. The control will have a Supply Air Sensor as standard.
6. The control will have a Return Air Sensor as standard.
7. The control will have an Outside Air Sensor as standard.
8. The control will use the Return Air Sensor in place of the Space Sensor if the Space Sensor fails for any reason, the control will have a 365 day Real Time Clock.
9. The Real Time Clock will be able to do automatic Daylight Savings Time adjustment.
10. The control will have an Occupancy Schedule that allows two different Occupied schedules per day for each of the seven days of the week individually.
11. The control will have 20 Holiday Schedules, each capable of 99 days.
12. The control's Holiday Schedules will have a start time associated with each schedule.
13. The control will control the Economizer directly.
14. The control will be capable of operating the Economizer using Dry Bulb, Outside Enthalpy, or Differential Enthalpy.
15. When the control is using Enthalpy to control the Economizer, it will also have an Outside Air Temperature enable Setpoint.
16. The control will use two setpoints for Supply Air Temperature for the Economizer operation. One will be for a small space cooling demand and one for a large space cooling demand.
17. The control will have the ability to do Demand Ventilation using one CO_2 sensor.
18. The control will have a programmable maximum Outside Air Damper Position for IAQ operation.
19. The control will have the ability to temper the ventilation air during times when heating or cooling is not required.
20. The control will have the ability to offset the operating setpoint based on high Humidity in the Space.
21. The control will have programmable limits when offsetting the Operating Setpoint to control Humidity.\
22. The control must be able to lockout Cooling below a programmable Outside Air Temperature Setpoint.
23. The control will be able to lockout Heating above a programmable Outside Air Temperature Setpoint.
24. The control will have a Space Temperature Alarm.
25. The control will have a Supply Air Temperature Alarm for Heating and Cooling. The Alarm temperature will be programmable.
26. The Control will be able to do a Pre-Occupancy Purge at a Programmable Time.
27. The control will have a hardware Smoke-Purge input.
28. The control will have the ability to read a dirty filter switch
29. The control will have the capability of reading a Fan proving switch.

30. The control will have an intelligent recovery function that will bring the space to the Occupied Setpoint just before or at the beginning of the first Occupied schedule each day. The control will learn and apply the minimum run time required to heat or cool the space to setpoint for the first Occupied period of a day.
31. The control will have Software controllable Mode Switches (Heat, Cool, and Fan).
32. The control will meter and track Unoccupied Override Time for billing purposes.

F. OPTIONAL SIMPLICITYLINC™ TRANSLATOR
1. The unit shall have an optional SimplicityLINC™ translator as an interface between a BACnet® control system and devices that communicate using the Modbus® RTU protocol. The SimplicityLINC™ shall be preconfigured to provide an interface to YORK UPG products equipped with an Intelli-Comfort™ or Simplicity Elite™ controller and allow monitoring and control by a third-party BACnet® Building Automation System (BAS).

2.46 Heat Recovery Ventilators- Exterior

A. General units shall be a packaged static plate enthalpic-energy recovery ventilator as manufactured by RenewAire technology or equal in a cabinet weatherized for outdoor use.

B. Quality Assurance

1. The energy recovery cores used in these products shall be certified by ARI under its Standard 1060 for Energy Recovery Ventilators. ARI published certifications shall confirm manufacture's published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently ARI Certified will not be accepted.
2. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA 90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.
3. Unit shall be listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers.
4. The RenewAire core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten years from the date of purchase. Balance of Unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two years from the date of purchase.

C. Energy Transfer

1. Shall be capable of transferring both sensible and latent energy between air streams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.

D. Passive Frost Control

1. Energy-transfer element shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional extreme conditions shall not affect the usual function or performance of the element. No condensate drains will be allowed.

E. Continuous Ventilation

1. Unit shall have the capacity to operate continuously without the need for bypass, recirculation, preheaters, or defrost cycles under normal operating conditions.

F. Positive Airstream Separation

1. Water vapor transfer shall be through molecular transport by hydroscopic resin and shall not be accomplished by "porous plate" mechanisms. Exhaust and fresh airstreams shall at all times travel in separate passages, and airstreams shall not mix.
2. Laminar Flow
   Airflow through the energy exchange element shall be laminar, avoiding deposition of particulates on the interior of the energy exchange plate material.

G. Construction

1. Energy-exchange module shall be of fixed-plate cross-flow construction, with no moving parts.
   a. No condensate drain pans or drains shall be allowed and unit shall be capable of operating in winter and summer conditions without generating condensate.
   b. Case shall be constructed of galvanized, 20-gauge steel, with lapped corners, and gasketed, zinc plated screw fasteners.
   c. Unit shall have single-point power connection.
   d. No Speed Control Allowed. External blower speed controls shall not be used.
4. Flange components shall be provided suitable for connection of ductwork.
5. Access door shall provide easy access to blowers, energy transfer elements, and filters. Panel shall be gasketed to provide air-tight seal.
6. Case walls and doors shall be insulated with 1" FSK high-density board insulation, eliminating the possibility of exposing the fresh air to glass fibers.
9. Energy-exchange element shall be protected by 30% efficient 2" nominal pleated, disposable filters.
10. Weatherhoods shall be screened to exclude birds and animals. Inlet weatherhood shall be sized to maintain inlet velocities below 500 fpm, and equipped with rain excluder baffles.
11. Blower motors shall be thermally protected with automatic reset, or supplied with starters.

H. Configuration

1. Unit shall be available from factory with vertical return air and vertical supply air duct connection openings.

I. Options

1. Non-pitched roof curbs shall be available from the factory for use with all configurations of the rooftop series units.
2. Units shall be capable of continuous 24/7 operation in winter and summer and just exhaust during economizer operation through remote, wall mounted switch and through contacts for control by BMS system.

2.47 BUILDING HOT WATER BOILERS AND ACCESSORIES

A. This Section includes gas-fired, condensing cast-iron boilers for heating hot water.

1. Related Sections include the following:
   a. "Breechings, Chimneys, and Stacks" for connections to breechings, chimneys, and stacks.
   b. Sections for control wiring for automatic temperature control.
2. Submittals shall include
   a. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated.
   b. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, and method of field assembly, components, and location and size of each field connection.
   c. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
   d. Source Quality Control Tests and Inspection Reports: Indicate and interpret test results for compliance with performance requirements before shipping.
   e. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
   f. Maintenance Data: Include in the maintenance manuals specified in Division 1. Include parts list, maintenance guide, and wiring diagrams for each boiler.
3. Quality Assurance shall include
   a. ASME Compliance: Boilers shall bear ASME "H" stamp and be National-Board listed.
   b. FM Compliance: Control devices and control sequences according to requirements of FM.
   c. Comply with NFPA 70 for electrical components and installation.
4. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."
5. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents. Installing contractor shall provide one year of warranty parts and labor.
   a. Special Warranty: Submit a written warranty, executed by the contractor for the heat exchanger.
   b. Warranty Period: Manufacturer's standard, but not less than 10 years from date of Substantial Completion on the heat exchanger. Warranty shall be non-prorated and not limited to thermal shock. Additional 21-year thermal shock warranty on heat exchanger.

B. Boilers shall be CSA design certified as a condensing boiler. Boilers shall be designed for a minimum of 5:1 continuous turn down with constant CO2 over the turndown range. The boiler shall operate with natural gas and have a CSA International certified input rating as noted on the drawings, and a thermal efficiency rating up to 99% at minimum input. The boiler shall be symmetrically air-fuel coupled such that changes in combustion air flow or flue flows affect the BTUH input without affecting combustion quality. The boiler will automatically adjust input for altitude and temperature induced changes in air density. The boiler will use a proven pilot interrupted spark ignition system. The boiler shall use a UL approved flame safeguard ignition control system using UV detection flame sensing. The UV detector shall be air cooled to prevent condensate formation and so designed as to prevent misalignment. The design shall provide for silent burner ignition and operation. The boiler shall be down fired counter flow such that formed condensate always moves toward a cooler zone to prevent re-evaporation. An aluminum corrosion resistant condensate drain designed to prevent pooling and accessible

condensate trap shall be provided. In some jurisdictions, a means of neutralizing the condensate Ph levels may be required. Boiler shall be able to vent a horizontal distance of 80 equivalent feet with a vent diameter equivalent to the combustion chamber outlet diameter.

1. Service Access: The boilers shall be provided with access covers for easily accessing all serviceable components. The boilers shall not be manufactured with large enclosures, which are difficult to remove and reinstall. All accesses must seal completely as not to disrupt the sealed combustion process. All components must be accessible and able to adjust with the removal of a single cover or cabinet component.
2. Indicating lights: Each boiler shall include a diagnostic control panel with a full text display indicating the condition of all interlocks and the BTUH input percentage. Access to the controls shall be through a completely removable cover leaving diagnostic panel intact and not disrupted.
3. Manufacturers: Manufacturer shall be a company specializing in manufacturing the products specified in this section with minimum five (5) years experience. Hydrotherm (a Mestek Company) is the basis of design. Listed acceptable manufacturers shall be subject to compliance with requirements. Provide boilers by one of the following:
   a. Aerco Benchmark BMK-2.0
   b. Viessmann Vertomat

C. Components shall include

1. Combustion Chamber: The combustion chamber shall be constructed of cast-iron. It shall be a down-fired design utilizing lightweight refractory around the burner housing.
2. Heat Exchanger: Boilers shall be a cast iron sectional unit designed for pressure firing and shall be constructed and tested for 100 P.S.I water working pressure, in accordance with the A.S.M.E. Section IV Rules for the Construction of Heating Boilers. Individual sections will have been subjected to a hydrostatic pressure test of 250 PSIG at the factory before shipment and they shall be marked, stamped or cast with the A.S.M.E. Code symbol. Boilers with less than 250-psi pressure test will not be acceptable for this project. The sections shall be of a down fired counter flow single-pass design. Water ports will be sealed with graphite port connectors. The sections will be fully machined for metal to metal sealing of the gas side surfaces. The design will provide for equal temperature rise through all sections. The heat exchanger shall be designed to prevent fluid boiling. The iron shall have a minimum thickness of ¼". The heat exchanger design should have no limitations on temperature rise or restrictions to inlet water temperature and a Cv of 60 (KN-6), 100 (KN-10), and 190 (KN-20).
3. Jackets: Stainless Steel.
4. Gas Burner: The burner shall be metal fiber mesh construction, allowing high turndown of the fuel-air mixture. The burner flame shall burn horizontally and be of the pre-mix type with a forced draft fan. Burner shall fire to provide equal distribution of heat throughout the entire heat exchanger. The burner shall be easily removed for maintenance without the disruption of any other major component of the boiler. A window view port shall be provided for visual inspection of the boiler during firing. The gas distribution components and burner shall be enclosed with a cast-aluminum housing.
5. Ignition components: The ignition hardware shall consist of Alumina ceramic insulated ignition electrodes and UV sensing tube permanently arranged to ensure proper ignition electrode and UV alignment.
6. Rated Capacity: The boiler shall be capable of operating at rated capacity with pressures as low as 2" W.C. at the inlet to the burner pressure regulator.

D. The burner shall be capable of 99% efficiency without exceeding a Nox reading above 11ppm. The burner and gas train shall be provided with the following trim and features:
   1. Burner Firing: Full modulation with 5:1 turndown @ Continuous CO2
   2. Burner Ignition: Interrupted spark
   3. Safety Controls: Energize ignition, limit time for establishing flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, and allow gas valve to open.
   4. Flue-Gas Collector: Enclosed combustion chamber with integral combustion-air blower and single venting connection.
   5. Gas Train: Manual gas valves (2), main gas valve (solenoid), manual test and check valves, pilot gas pressure regulator, and automatic pilot gas valve. All components to be factory mounted and CSD-1 compliant.
   6. Safety Devices: Low gas pressure switch, air-flow switch, and blocked flue detection switch, low water cutoff (manual reset), high temperature manual reset. All safeties to be factory mounted.
   7. Individual gas regulator provided by factory, shipped loose for field installation, one per boiler.

E. Controls: The boiler control package shall be a MTI Heat-Net or equivalent, integrated boiler management system. The control system must be integral to each boiler, creating a control network that eliminates the need for a "wall mount" stand-alone boiler system control. Additional stand-alone control panels, independent of a Building Management System (BMS), shall not be allowed to operate the boiler network.

   1. The Heat-Net control shall be capable of operating in the following ways:
      a. As a stand-alone boiler control system using the Heat-Net protocol, with one "Master" and multiple "Member" units.
      b. As a boiler network, enabled by a Building Management System (BMS), using the Heat-Net protocol, with one "Master" and multiple "Member" units.
      c. As "Member" boilers to a Building Management System (BMS) with multiple input control methods.
   2. A boiler becomes a Master when a resistance type 10K sensor is connected to the J10 "SYS/DHW HEADER" terminals. The sensor shall be auto detected. The Master senses and controls the header/loop temperature utilizing a system setpoint. It uses any boilers it finds "Heat-Net Members" or those defined in the control setup menus to accomplish this. The "Master" shall also have the option of monitoring Outside Air Temperature "OA" to provide full outdoor air reset functionality. Only one master shall be allowed in the boiler network.
      a. When operating as a "Master", the Heat-Net control provides a stand-alone method using a PID algorithm to regulate water temperature. The algorithm allows a single boiler "Master" or multiple "Master + Member" boilers in a network of up to 16 total boilers.
      b. The control algorithm is based upon a control band, at the center of which is the setpoint. While below the control band, boilers are staged on and modulated up until the control band is entered. Once in the control band, modulation is used to maintain setpoint. Optimized system efficiency is always accomplished by setting the Modulation Maximum "Mod-Max" setting to exploit each boiler in the network's inverse efficiency curve. The control shall operate so that the maximum number of boilers required, operate at their lowest inputs until all boilers are firing. Once all boilers are firing, the modulation clamp is removed and all boilers are allowed to fire above this clamped percentage up to 100%. This "boiler efficiency" clamp is defaulted to 80% and thus limits all the boilers individual outputs to 80% until the last boiler fires. The 80% default must be

field adjustable for varying operating conditions. All boilers modulate up and down together always at the same modulation rate. Boilers are shut down only when the top of the band is breached, or before the top of the band, if the control anticipates that there is a light load. Timers shall also be included in each control in the network to prevent any boiler from short cycling.

3. Additional boilers in the network always default to the role of member. The lack of sensors connected to the J10 terminals "SYS/DHW Header" on each additional boiler shall ensure this.
   a. Each "Member" shall sense its supply outlet water temperature and modulate based on signals from a Building Management System (BMS) or "Master" boiler. When operating as a member, starting, stopping, and firing rate shall also be controlled by the "BMS" or "Master" boiler.
   b. When using the Heat-Net protocol, the system setpoint shall be sent from the "Master", along with the modulation value to control firing rate. It also receives its command to start or stop over the Heat-Net cable. Each "Member" will continuously monitor its supply outlet temperature against its operating limit. If the supply temperature approaches the operating limit temperature (adjustable), the boilers input control rate is limited and its modulation value decreases to minimize short cycling. If the operating limit is exceeded, the boiler shall shut off.

F. Each Heat-Net control in the boiler network shall have the following standard features:

1. Digital Communications Control.
   a. Boiler to Boiler: Heat-Net
   b. Building Management System (BMS) with MODBUS standard protocol and BACNET and LONWORKS as optional protocols.
2. Analog 4:20 and 0-10vdc also supported.
3. Distributed control using Heat-Net protocol for up to 16 total boilers.
4. System/Boiler operating status in English text display.
5. Interlock, Event, and System logging with a time stamp.
6. Advanced PID algorithm optimized for specific boilers (KN-Series).
7. Four dedicated temperature sensor inputs for: Outside Air Temperature, Supply (Outlet) Temperature, Return Temperature (Inlet), and Header Temperature.
8. Automatically detects the optional temperature sensors on start up.
9. Menu driven calibration and setup menus with a bright 4-line Vacuum Fluorescent Display.
10. (8) Dedicated 24vac interlock monitors and 8 dedicated 120vac system monitors used for diagnostics and providing feedback of faults and system status.
11. Multiple boiler pump or motorized boiler valve control modes.
12. Combustion Air Damper control with proof time.
13. Optional USB/RS485 network plug-in to allow firmware updates or custom configurations.
14. Optional BACNET and LONWORKS interface.
15. Alarm contacts.
16. Runtime hours.
17. Outdoor Air Reset with programmable ratio.
18. Time of Day clock to provide up to four (4) night setback temperatures.
19. Failsafe mode when a Building Management System (BMS) is controlling setpoint. If communications is lost, the boiler/system shall run off the Local Setpoint.

G. Boiler Trim Shall Include

1. Safety-Relief Valve: ASME rated, factory set to protect boiler and piping as per schedule/drawings. 100 psi maximum allowable working pressure
2. Gauge: Combination water pressure and temperature shipped factory installed. LCD outlet temperature readout to be an integral part of the front boiler control panel display to allow for consistent easy monitoring of temperatures factory mounted and wired.
3. Burner Controls: Boiler shall be provided with a Honeywell RM7800 series digital flame safe guard with UV rectification. The flame safe guard shall be capable of both pre and post purge cycles.
4. High Limit: Temperature control with manual-reset limits boiler water temperature in series with the operating control. High Limit shall be factory mounted and sense the outlet temperature of the boiler through a dry well.
5. The following standard trim:
   a. Aluminum Condensate Receiver Pan
   b. Low Air Pressure Switch
   c. Blocked Flue Detection Switch
   d. Modulation Control
   e. Temperature/Pressure Gauge
   f. Manual Reset High Limit
   g. Low Gas Pressure Safety Switch
   h. Low Water Cutoff with Manual Reset (CSD-1)
   i. Gas Pressure Regulator to provide 4" Incoming Pressure to Main Gas Valve – Shipped Loose for Field Installation.
   j. Air inlet filter
   k. Supply Outlet Temperature Display
   l. Full Digital Text Display for all Boiler Series of Operation and Failures
   m. Air Inlet Filter
   n. Variable Frequency Drive and Combustion Air Fan with Safety Interlock
   o. Condensate Drain
6. PROVIDE THE FOLLOWING JOB SPECIFIC TRIM AND FEATURES
   a. High Gas Pressure Switch and Valve Proving Switch for IRI Compliant GasTrain
7. Boiler Blower Motor: Blower motor shall be externally mounted for ease of service. There shall be no requirement to remove covers or gas train components to remove the blower motor. The KN-10 Blower shall be .5 HP and FLA not to exceed 8 Amps.
8. Test and inspect boilers according to the ASME Boiler and Pressure Vessel Code, Section IV. Boilers shall be test fired in the factory with a report attached permanently to the exterior cabinet of the boiler for field reference.

H. Installation

1. Examine area to receive boiler for compliance with requirements for installation tolerances and other conditions affecting boiler performance. Do not proceed with installation until unsatisfactory conditions have been corrected.
2. Install boilers level and plumb, according to manufacturer's written instructions and referenced standards.
3. Install gas-fired boilers according to NFPA 54.
4. Support boilers on a minimum 4-inch thick concrete base, 4 inches larger on each side than base of unit.
5. Install electrical devices furnished with boiler, but not specified to be factory mounted.
6. Connect gas piping and individual regulator, full size, to boiler gas-train inlet with union.
7. Connect hot water piping to supply and return boiler tappings with shutoff valve and union or flange at each connection.
8. Install piping from safety-relief valves to nearest floor drain.

9. Connect breeching to boiler outlet, full size of outlet. The boiler shall operate under positive (Category IV) or negative (Category II) stack pressure. Vent material must be listed AL29-4C Stainless Double Wall Stack for condensing appliances.
10. Electrical: Comply with applicable requirements in Division 16 Sections.
    a. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

I. Set Up

1. Manufacturer's Field Service: Engage a factory-authorized service representative to supervise the field assembly of components and installation of boilers, including piping and electrical connections. Report results in writing.
    a. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Boiler shall be commissioned by factory-authorized technician. Contact local representative for factory authorized technician information.
2. Manufacturer’s representative shall supply a factory authorized service technician to start up the boilers.
3. Flush and clean boilers on completion of installation, according to manufacturer's written instructions.
4. After completing boiler installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes including chips, scratches, and abrasions with manufacturer's stainless steel polish.

J. Start Up
1. Engage a factory-authorized service representative to provide startup service. Start up to be performed only after complete boiler room operation is field verified to offer a substantial load, and complete system circulation. One-year warranty shall be handled by factory authorized tech.
2. Verify that installation is as indicated and specified.
    a. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16 Sections. Do not proceed with boiler startup until wiring installation is acceptable to equipment Installer.
3. Complete manufacturer's installation and startup checklist and verify the following:
    a. Boiler is level on concrete base.
    b. Flue and chimney are installed without visible damage.
    c. No damage is visible to boiler jacket, refractory, or combustion chamber.
    d. Pressure-reducing valves are checked for correct operation and specified relief pressure. Adjust as required.
    e. Clearances have been provided and piping is flanged for easy removal and servicing.
    f. Heating circuit pipes have been connected to correct ports.
    g. Labels are clearly visible.
    h. Boiler, burner, and flue are clean and free of construction debris.
    i. Pressure and temperature gages are installed.
    j. Control installations are completed.
4. Ensure pumps operate properly.
5. Check operation of gas pressure regulator device on gas train, including venting.
6. Check that fluid-level, flow-switch (optional), and high-temperature interlocks are in place.

7. Start pumps and boilers, and adjust burners to maximum operating efficiency.
   a. Fill out startup checklist and attach copy with Contractor Startup Report.
   b. Check and record performance of factory-provided boiler protection devices and firing sequences.
   c. Check and record performance of boiler fluid-level, flow-switch (optional), and high-temperature interlocks.
   d. Operate boilers as recommended or required by manufacturer.
8. Perform the following tests for maximum and minimum firing rates for modulating burner. Adjust boiler combustion efficiency at maximum and minimum modulation rates. Perform combustion flue gas test at minimum and maximum modulation rate. Measure and record the following:
   a. Differential pressure across air / gas orifice.
   b. Combustion-air temperature at inlet to burner.
   c. Flue-gas temperature at boiler discharge.
   d. Flue-gas carbon dioxide, oxygen, and carbon monoxide concentration.
   e. Flue gas Nox emissions where applicable.
   f. Natural flue draft.
9. Measure and record temperature rise through each boiler.

K. Training

1. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
   a. Operate boiler, including accessories and controls, to demonstrate compliance with requirements.
   b. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
   c. Review data in the maintenance manuals. Refer to Division 1 Section "Contract Closeout."
   d. Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
   e. Schedule training with Owner with at least 7 days' advance notice.

2.48 PIPING, FITTINGS, AND JOINTS

A. Provide all piping, fittings, flanges, unions, bolting, gaskets, welding, threading and soldering for main piping network, branches and connections to equipment.
B. All piping shall be clearly marked with material specification.
C. All pipe and material shall comply with the requirements and recommended practices of ASME B31.9 Building Services Piping Code.
D. Provide drains at low points and vents at high points of all piping systems and between pumps and check valves.
E. Hot water and steam piping shall be Schedule 40 Steel for pipe sizes 2-1/2 and greater; Schedule 40 Copper for sizes 2” or less. Condensate piping shall be Schedule 80 for all sizes. All drain piping shall be Copper.

2.49 AIR VENTING AND DRAINAGE

A. Grade all piping for drainage through equipment or through accessible drain valves so that system can be conveniently freed of water by gravity flow.
B. All high points in closed water piping systems shall be relieved of air through accessible manual vents on the high points of the pipe lines and at the equipment.
C. Vent valves on piping and equipment shall be 1/2" ball valves with chains and caps and with discharge pipes to convenient points for catching discharge.

2.50 THERMOMETERS, GAUGES AND PRESSURE/TEMPERATURE TAPS

A. Provide thermometers and gauges as shown on the drawings, and at inlets and outlets of all air handling unit coils, at pumps, etc. Provide pressure taps and thermometer wells for all in-duct or in-box water coils.

2.51 INSULATION

A. All insulation materials, finishes, coatings, cements, jackets and other insulation accessories shall have minimum composite or individual fire hazard ratings as well as thickness and "C" values conforming to State Building Codes which control building construction materials that may be used on this project. Where specification requirements exceed the Code requirements, the specification shall govern. Insulation shall be as manufacturer by Owens Corning, John Manville, Armstrong or approved equal.

B. Insulation for the various systems and associated equipment shall be composed of materials, which are non-combustible and/or provide a fire resistive system of insulation, which complies with the applicable Code having jurisdiction.

C. Insulation Fire hazard ratings shall not exceed Flame Spread Rating 25, Smoke Developed Rating 50.

D. Hot water piping, low pressure steam and boiler blow-down pipe insulation shall be 1-1/2” for Hot water pipe sizes up to 2” and 2” for pipe sizes greater than 2”. All insulation shall have All-service-jacket facing.

E. Medium and High pressure Steam and Condensate piping insulation shall be 2-1/2” for sizes up to 2” and 3” for sizes graeter than 2”. Interior MPS & LPS shall have a jacket of A finish jacket of H.K. Porterlag Lagging Cloth having a treated weight of 16 oz./sq.yd. Exterior HPS and PC piping shall be double thickness with aluminum jacket. Aluminum jacket shall be 0.020 inch thick conforming to ASTM B-209 with a 3 mil factory applied polykraft moisture barrier.

F. Drain piping, refrigeration and cold water make-up insulation shall be 1”.

G. All piping within mechanical room and in exposed areas shall have Cell Co plastic jacket.

H. Supply ductwork shall be 1-1/2” fiber board insulation. Ductwork insulation shall have FSKL facing 0.35 mil aluminum foil reinforced with fiberglass yarn reinforcing scrim and laminated to chemically treated fire resistive Kraft paper having a minimum 35 pound per inch width tensile strength when tested in accordance with ASTM D 828. Longitudinal laps and butt strips shall be a minimum of 3 inches. duct installation, sealing and testing is completed by the Mechanical Contractor Ductwork insulation exposed to weather shall be insulated with 2 inch thick fiber glass rigid board insulation with vapor barrier Exterior insulation shall also be be covered with EPDM roofing material with the joints overlapping minimum of 6 inches. All joints shall be staggered and shall be covered with mastic to ensure a weatherproof system.

2.52 AIRE DISTRIBUTION DEVICES

A. General - Provide diffusers, registers and grilles as shown and scheduled on the drawings and herein specified. Diffusers shall be as manufactured by Tuttle & Bailey, MetalAire or approved equal.

B. All diffusers, grilles and registers shall be equipped with factory mounted opposed blade dampers. All air distribution devices shall be of steel or aluminum construction unless otherwise specified herein or scheduled on the drawings.

C. Ceiling Supply - Ceiling or sidewall supply air diffusers of the above types shall be of the restricted multi-orifice jet induction and air mixing type, consisting of louvered sections with built-in diffusing vanes, as manufactured by Tuttle & Bailey Type RCTC or MetalAire Series 5000 IV.

D. Return and Exhaust - General return/exhaust registers shall be equal to Tuttle & Bailey Model T77D or MetalAire Model RHD. All return and exhaust registers installed in all toilet rooms, locker rooms and showers, and other areas subject to moisture shall be similar to above except constructed of all aluminum , including opposed blade dampers, equal to Tuttle & Bailey Model A77D.

E. Sidewall Adjustable Supply - Sidewall supply registers shall be equal to Tuttle & Bailey Model T547 or MetalAire Model H4004SD,

F. Linear Supply and Return – Linear supply and return diffusers shall be equal to Tuttle & Bailey Model EH or MetalAire Model 2000D.

2.53 FINNED TUBE RADIATION

A. Furnish and install where shown on the plans, finned tube radiation as manufactured by Sterling, Vulcan, Slant-Fin, or approved equal. Ratings shall be IBR approved.

B. Heating element type and capacity shall be as scheduled on plans. The element shall be seamless copper tubing, mechanically expanded to aluminum fins.

C. Brackets and hangers shall be 14 gauge, galvanized steel, channel type. Silent horizontal movement during expansion and contraction shall be provided by 18 gauge element support cradle. Bracket shall interlock with backplate channel and provide full engagement enclosure lock.

D. Full backplate shall be 20 gauge steel with mounting channel and slots for mounting brackets.

E. The enclosure shall be 16 gauge steel of style shown on plans, and shall be (baked primer finish suitable for field painting) (baked enamel finish in color selected by Architect from standard color charts. Submit color charts with shop drawings). Welded male and female slip joints are to be provided for positive engagement and alignment of enclosures. Internal 14 gauge gussets (minimum of two) are to be welded at each end of enclosure.All necessary trim is to be provided for a completely finished job.

F. All covers shall run wall-to-wall or wall-to-end cap, as applicable or as required. Provide access door, or easily removable access section for each control or shut-off valve. Door shall require tool for opening. Dampers shall be provided, when indicated on plans, shall have rolled edges and be knob operated.

G. Zone Valves And Thermostats

1. Valves shall be as manufactured by Erie Valve Company, Honeywell or equal, □", 24 V, with 40 VA transformer for each thermostat.
2. Thermostat shall be 24 V with 50□F to 85□F range and shall be compatible with zone valves.

H. Self-Contained Control Valves

1. Thermostatic heating control valves shall be furnished and installed where shown on the drawings. Sizes of valves shall be to suit the capacity of the heating element indicated.
2. Control valve shall be automatic, self-contained, nonelectric, modulating type as manufactured by Danfoss, Macon, or Taco.
3. The control unit shall consist of one stainless steel bellow, and one beryllium copper bellow, nickel-plated copper sensor, and plastic knob.
4. Valve body available in angle or straightway pattern for hot water or low pressure two pipe steam. The valve body shall be with stainless steel disc, seat, and return spring.

2.54 AUTOMATIC SMOKE AND FIRE DAMPERS

A. H&V Subcontractor shall furnish and install where shown on the plans, combination fire and smoke dampers constructed and tested in accordance with UL 555. Each damper shall possess a 1□ hour fire protection rating and shall contain a UL label. The electric damper motor shall have sufficient torque characteristics to operate the size damper indicated.

1. Damper motors shall be furnished as an integral part of the damper by the manufacturer. Damper motors shall be spring return type that allow dampers to close on power interruption and shall require 120 VAC power to open. Motors shall be completely installed and linked ready to operate the damper. Motors shall be installed inside of the duct systems and shall be removable for service or replacement.
2. Dampers shall be combination fire and smoke dampers capable of being mechanically reset.
3. Units shall be signaled from a smoke detector. The smoke detector and related wiring shall be by the Electrical Contractor. The dampers and motor operator shall be furnished and installed by the H&V Contractor, wired by the Electrical Contractor.
4. Dampers shall be Prefco Products, Inc., Model No. 5030 or similar by Phillips or Ruskin.
5. Installation diagram shall be provided with submittal.

B. Smoke Exhaust Control: (System No. 1)

1. On sensing of smoke by smoke detector (located in corridor and furnished and installed by Electrical Subcontractor), all return air automatic dampers shall close, except on floor of incidence.
2. At same time, the automatic damper in supply air register at floor of incidence shall close to preset maximum position, the remainder being left open. Supply air fan shall continue to operate.
3. The automatic damper in return air duct shall close; outside air damper shall open fully; and damper to smoke exhaust fan shall open. Smoke exhaust fan shall operate.
4. A reset switch (furnished and installed on fire panel by Electrical Subcontractor) shall reset dampers to normal positions and shutoff smoke exhaust control.

5. All of the wiring for this system shall be furnished and installed by the Electrical Subcontractor to provide this sequence of control. The Mechanical Subcontractor shall coordinate with the Electrical Subcontractor.
6. Unit smoke detectors shall shut down unit.
7. Dampers shall be Prefco Products, Inc., Model No. 5030 or similar by Phillips or Ruskin.
8. Installation diagram shall be provided with submittal.

C. Smoke Exhaust Control: (System No. 2)

1. On sensing of smoke by smoke detector (furnished and installed by the Electrical Subcontractor), corridor makeup air unit shall stop.
2. At same time, the automatic damper in exhaust air register at floor of incidence shall open, the reminder being left closed and smoke exhaust fan shall operate.
3. A reset switch (furnished and installed on the fire panel by the Electrical Subcontractor) shall reset dampers to normal positions, shutoff smoke exhaust fan, and start corridor makeup air unit.
4. All of the wiring for this system shall be furnished and installed by the Electrical Subcontractor to provide this sequence of control. The Mechanical Subcontractor shall coordinate with the Electrical Subcontractor.

3 PART 3-EXECUTION

3.1 WORKMANSHIP

A. All work shall be coordinated with the work to be installed by other sections of these specifications.

B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.

C. All duct supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this section.

D. Nameplates, catalog numbers, and rating identifications shall be securely attached to equipment.

E. The work shall be performed in a timely manner so as to cause no delay in the overall job progress. The Contractor shall cooperate with the other trades so that the work is installed in the most beneficial sequence for expeditious project completion.

F. Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

G. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment

H. Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electrical Code (NEC).

I. All wiring shall be verified for its integrity to ensure continuity and freedom from shorts and grounds

J. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.2 CLEANING OF SYSTEMS AND PREMISES

A. Before the systems are tested and balanced, all ducts serving the area under construction shall be cleaned so that no dirt, dust or other foreign matter will be carried through or deposited in the systems or the space served by the duct systems.

B. At all times keep the premises clear of rubbish.

C. Upon completion of the work in an area, remove all debris and rubbish resulting from the execution of this contract, and dispose of same. At anytime should the General Contractor be dissatisfied with the performance of the HVAC Contractor's clean up responsibilities, he may elect after notifying the HVAC Contractor to undertake this operation and to backcharge the HVAC Contractor accordingly.

3.3 HVAC CONTRACTOR'S WARRANTY

A. The HVAC Contractor shall provide a one year warranty against failure of the installed materials for any reason. The warranty shall cover the full costs of parts and labor required to remedy the defect, including, if necessary, replacement at the site, and shall run from the date of the Architect's acceptance of the system. The warranty shall also include provision for field inspection at no charge to the Owner, to verify failure, establish probable cause, and determine corrective action required. The HVAC Contractor shall furnish all service during the first year of operation. Any material that in the opinion of the architect, requires excessive service during the first year of operation shall be considered defective and will be replaced by the HVAC Contractor at no charge to the Owner.

B. The HVAC Contractor shall provide a listing of all manufacturer's commercial warranties provided by those manufacturers on their Materials. The list of these warranties must include the time period of each warranty. One copy each of those warranties shall be submitted with the listing.

C. The HVAC Contractor shall be responsible for warranting the testing, adjusting and balancing work for a period of one year after final date of completion. The HVAC Contractor shall also be responsible for all damage to existing systems as a result of the work performed. All damaged systems shall be repaired or replaced at the option of the Owner at no additional cost to the Owner. All such repair or replacement work shall be done immediately upon finding.

D. Warranty response to any malfunction shall be on a next day, normal working hour basis.

E. Work under warranty shall be performed by fully qualified workmen and/or technicians.

F. All guarantees and warranties required to be provided for the work in this Section shall begin their term on the date of final written acceptance of the entire system by the Owner.

3.4 SUBMITTALS

A. The capacity of each HVAC unit shall be substantiated by computer generated selection data or other detailed selection data provided by the manufacturer, for the specific conditions defined on the drawings. Submit 7 copies for approval.

1. The selection data shall clearly show the entering and leaving fluid conditions, the fluid flow volume and the fluid pressure drop through the unit, the ambient conditions, the heat rejection media entering and leaving conditions, the available external static pressure, the unit total static pressure, the airside pressure drops, the refrigerant and the saturated suction temperature, the required RPM of the unit, the motor horsepower, the motor voltage, the motor efficiency, the motor RPM, the motor type, the fuel efficiency, the fuel consumption rate, the maximum capacity, the part load performance data of the anticipated operation of the system, and the radiated sound ratings at design conditions as may be appropriate for any specific piece of equipment.

B. Contractor shall submit shop drawings indicating the method of supporting all units.

3.5 PERFORMANCE

A. The drawings are diagrammatic and the final arrangement of the work shall suit the existing and field conditions, the characteristics of the materials used and the instructions of the Engineer and/or the Architect.

B. The Contractor shall be responsible for repair of damaged or disturbed existing work or the work of other trades caused by his work, testing of his work or repair to his work.

C. All devices shall be installed in accordance with the manufacturer's recommendations, the Engineer's instructions and so as to provide all required access for cleaning, operation, repair and maintenance.

3.6 START UP

A. All equipment, systems, controls and units shall be started as part of a heating, ventilating and air conditioning system, in accordance with all manufacturers' recommendations.

B. Manufacturer's Representative shall start up the RTU chillers and boilers and all other major equipments.

3.7 RECTANGULAR DUCTS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

B. Sealing

All ductwork shall be sealed in accordance with the following table:

SMACNA SEAL CLASS	SEALING REQUIRED	SMACNA STATIC PRESSURE CONSTRUCTION CLASS
A	All transverse joints All longitudinal seams All duct wall penetrations	4" W.G. and up
B	All transverse joints All longitudinal seams	3" W.G.
C	All transverse joints	2" W.G. and down

1. For the purposes of these specifications sealing shall mean the following:
2. The use of adhesives, gaskets, liquids, mastics, hot melt sealant, pressure sensitive tape or combinations thereof to close openings in the surface of the ductwork and field erected plenums and casings through which air leakage would occur.
3. The requirements to seal apply to both positive and negative pressure modes.
4. Pressure sensitive tape shall only be acceptable for sealing ductwork which operates at a static pressure of ½" or less.

5. Liquid sealant shall only be acceptable for slip joints where metal clearances do not exceed 1/16".
6. Gaskets shall be used for all flanged connections and shall have an adhesive backing to adhere to the flange during assembly of the joint.

C. Reinforcement

1. Unless specified otherwise on the drawings rectangular ductwork shall be constructed and reinforced per the following "Rectangular Duct Reinforcement" tables, where the duct wall thickness, the reinforcement spacing and the rigidity class are specified by duct size and pressure classification. Rigidity class designations are based on the SMACNA standards for "Intermediate Reinforcement" and "Transverse Joint Reinforcement" as published in the SMACNA "HVAC DUCT CONSTRUCTION STANDARDS - Metal and Flexible".
2. Duct sides that are 19" and over and are 20 gauge or less with more than 10 square feet of unbraced panel shall be cross broken or beaded unless they are lined or externally insulated.
3. Fittings shall be reinforced similarly to sections of straight duct. On size change fittings the greater fitting dimension determines the duct gauge. Where fitting curvature or internal members provide equivalent rigidity, such features may be credited as reinforcement.
4. The duct side with the largest dimension shall determine the duct gauge.
5. Holes made in the duct walls for the passage of tie rods shall be of minimum size and shall be sealed in accordance with the required duct seal classification.
6. Where used tie rods shall be evenly spaced in the width of the duct dimension.

D. Transverse Joints

1. Transverse joints shall be selected and used consistent with the static pressure class, sealing requirements and duct support intervals for proper assembly.
2. Where bar or angle stock is incorporated in a joint it shall be secured.
3. Fasteners shall be steel and may be zinc or cadmium coated. They shall not project into duct more than ½".
4. Where bolts or welds are specified other types of fasteners shall not be used.

E. Seams

1. Seams shall be suitably selected for the material and pressure classification of the duct.
2. Seams shall be formed and assembled with proper dimension and proportion for tight and secure fit.

3.8 ROUND DUCTS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

B. Duct Gauge

1. Round ducts shall be constructed of the galvanized steel with duct walls in accordance with "SMACNA" standards.

3.9 FLEXIBLE DUCTS

A. Use

1. All flexible duct used on the supply air system shall be insulated with 1½" thick vinyl jacketed fiberglass insulation.

B. Length

1. The minimum length of flexible duct shall be used.
2. The maximum length of flexible duct in any single duct run shall be four feet.

C. Bends

1. Bends shall be made with not less than one and one half duct diameter centerline radius.
2. Maximum bend shall be 90^{o}.

D. Fastening

1. Secure flexible duct to collar or sleeve by peeling back jacket and insulation at end of flexible duct. Fit duct over collar or sleeve and clamp with ½" wide galvanized steel or stainless steel bands or clamps and matching seals. Pull jacket and insulation back in place and secure with two wraps of pressure sensitive sealing tape. Clamping device shall be two inches back from end of flexible duct. Seal with two wraps of duct tape.

I. Installation

1. Flexible duct is to be installed as straight as possible and as tight as possible.
2. Submittals shall include product data sheets as well as the manufacturer's recommended installation practices.

3.10 SUSPENSION OF DUCTWORK

A. Rigid round and rectangular ducts shall be installed with support systems as required to maintain alignment. Horizontal ducts shall have a support within two feet of each elbow and within four feet of each branch intersection.

B. Strap hangers on rectangular ducts may be used on ducts less than 60" wide if they are secured to the bottom of the duct with an approved fastener and with a minimum 1" tab below the duct, or with no fasteners if the strap is a single continuous loop.

C. Multiple trapeze hangers may be suspended from rod hangers to support ducts directly above and below each other if the rods are sized to support the combined load.

D. Round ducts less than 10" in diameter may be suspended by wire.

E. All hangers and trapezes shall be sized, spaced and selected in accordance with Section IV of SMACNA "HVAC DUCT CONSTRUCTION STANDARDS".

3.11 MISCELLANEOUS DUCT WORK REQUIREMENTS

A. Ductwork connected to intake or discharge louvers shall be painted inside for the first ten feet with bitumastic and pitched to a low point. The low point is to be provided with a 1½" copper drain piped by this trade to a building drain.

B. A gasket type joint shall be used where dissimilar metals are joined.

3.12 RECTANGULAR DUCT FITTINGS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

3.13 ROUND DUCT FITTINGS

A. Elbows larger than 8" shall be five piece welded construction.

B. Branch and take-off fittings shall be conical tee or conical reducing tee fittings.

C. Final connections to the individual terminal supply units shall be by means of flexible duct.

3.14 PIPE HANGERS, SUPPORTS, ANCHORS AND GUIDES

A. Contractor shall submit shop drawings indicating the method of supporting all piping furnished by this trade.

B. The Structural Engineer or Architect must approve the method of hanging before work is commenced.

C. Shop drawings of anchors shall be submitted before work is commenced.

D. Shop drawings of guides shall be submitted before work is commenced.

E. Sleeves of the specified type shall be installed wherever pipe lines penetrate walls, roofs, floors or partitions.

F. Sleeves shall be installed in accordance with the requirements of NFPA and the Massachusetts State Building Code.

3.15 VALVE TAGS

A. Valve tag scheme shall be approved by the Engineer prior to installation in the field and insertion on the record drawings.

B. Contractor shall provide a valve tag chart and clearly label the valve tags on the record drawings. The valve chart shall include but not be limited to: tag #, location, valve type, size, how valve operates (solenoid, modulating, manual).

C. Valve tags shall be securely fastened to the valve handle by heavy aluminum or brass hooks or chain.

3.16 VIBRATION ISOLATION

A. All equipment, piping, etc. shall be mounted on or suspended from approved foundations and supports, as specified herein or as shown on the drawings.

B. Mounting sizes shall be determined by the mounting manufacturer and the mountings shall be installed in accordance with the manufacturer's recommendations. The Contractor shall be responsible for the adequacy of the mountings to provide the minimum isolation efficiency required by these specifications or as specifically noted on the drawings.

C. Suspended centrifugal fans shall be installed on vibration isolation hangers.

3.17 PIPING SYSTEM INSTALLATION AND ASSEMBLY

A. All piping shall be installed at right angles to building surfaces, supports and structures.

B. Pipe welding shall performed by a certified welder with oxy-acetylene or electric arc in accordance with the latest revision of the applicable code, ASME Boiler Construction Code, ASA Code for Pressure Piping, or state and/or local codes which may supersede codes mentioned.

C. Threaded joints shall be made with Teflon tape only applied to male threads and care being taken to insure that the tape does not reach the interior of the pipe. All burrs and/or cuttings shall be removed and the pipe shall be reamed or filed out to not less than the original diameter. Piping shall be kept free from scale and dirt.

D. All pipe shall be straight, true and round without obstructions and with sharp, full cut threads or with ends beveled for welding.

E. Provide drain valves with hose connections at all low points and at the bottoms of all risers to allow for complete drainage of the system.

F. All openings shall be capped or plugged during construction to prevent dirt and/or rubbish from entering the piping.

G. Unions or flanged connections shall be placed wherever necessary to permit easy dismantling of the piping and equipment.

H. Where possible, piping shall be grouped together and supported in a neat and orderly manner.

I. Insulating bushings or dielectric nipples shall be provided between steel piping and copper piping on equipment.

J. Air vents shall be provided where indicated on the drawings and at all high points in the water systems.

K. Pipe must be supported before and after expansion compensation devices.

L. Mount all pressure gauges to be read from the floor.

M. Install pressure gauges on the suction and discharge of pumps.

N. Provide two spare pressure gauges of each pressure range and type.

O. Mount all thermometers to be read from the floor.

P. Install thermometers on the supply and return of the chill water system.

Q. Provide two spare thermometers of each range and type.

3.18 FLUSHING OUT TREATMENT

A. After completion of the installation of the piping system and prior to the start up of the systems, the system shall be flushed out with chemicals.

B. The flush out compound shall be trisodium phosphate, three percent by weight.

C. Flush out recirculation shall be for a period of not less than 48 hours.

D. Tests shall be performed following the chemical flushing out and a report shall be issued in writing to the Architect, stating that the cleaning and flushing has been completed satisfactorily.

E. Allowable chemical concentrations after flushing out shall be phosphate - zero, alkalinity - 100 parts per million maximum, suspended solids - zero.

3.19 DUCT INSULATION - DUCT WRAP

A. All work shall be in strict accordance with applicable codes and ordinances and the manufacturers recommendations.

B. All completed work shall be smooth in appearance.

C. Seams shall be stapled 6" on center with outward clinching staples and sealed with pressure sensitive aluminum foil tape.

D. All seams, joints punctures and tears shall be sealed with pressure sensitive aluminum, foil tape.

E. All make-up air ductwork, air conditioning supply ductwork, and ductwork connected to SF-1 shall be insulated. All exterior insulated ductwork shall be weather proofed per Section 2.7.

3.20 BALANCING DAMPERS

A. All branch ducts, balancing dampers shall be located as shown on the drawings or any place requiring one, in the following locations as a minimum: shall have a balancing damper.

1. All supply and return air branches from the trunks and all sub-branches from the mains shall have balancing dampers.
2. Branch duct connections from low pressure ducts to diffusers shall be made with dampered spin collars.

B. Locate dampers as far as possible from air outlets.

3.21 FINAL ACCEPTANCE

A. The Contractor shall leave all system components in proper working order, such as belt guards in place, access doors closed, doors to electrical switch boxes closed, thermostats restored to specified setting. All recorded data shall represent a true, actually measured, or observed condition. Any abnormal conditions in the mechanical systems or conditions which prevent total system balance, shall be reported to the Architect immediately upon finding. The Contractor shall permanently mark all dampers and other adjustment devices in a manner that will allow the settings to be restored.

B. The Contractor shall verify control system operation as specified, and shall report all system problems and malfunctions. The verification and checkout of the control system shall be accomplished during the heating and cooling cycles of operation for an appropriate period of time to assure control response and overall stability.

C. The Contractor shall verify that all air systems are in compliance with all standards, such as ASHRAE minimum outside air, and all other applicable codes and requirements.

D. All filters shall be replaced by the Contractor before commencing.

E. The Contractor shall make any necessary changes in fan speed, and shall realign all belts when necessary.

3.22 AIR AND WATER BALANCING

A. The HVAC Subcontractor shall employ an independent Balancing subcontractor, acceptable to and approved by the Architect/Engineer, to balance and adjust the air and water systems.

B. Balancing and adjusting shall not begin until all HVAC systems have been installed and are in full working order. Prior to the start of balancing, the following shall be checked:

1. Rotation of all fans and pumps.
2. Dampers are free to open and close
3. Fire and smoke dampers are open.
4. Clean filters are in place.

C. Upon completion of balancing and adjusting of the systems hereinafter specified, submit six (6) copies of the data for review and approval by the Architect/Engineer.

D. The balancing Subcontractor shall be procured early enough in the project to allow for him/her to review the project documents and determine if sufficient components are in place to balance and adjust the systems. The balancing subcontract shall provide a list of any deficient are he/she identifies.

E. Balancing Subcontractor shall provide all testing instruments, manpower, temporally connections and materials needed for balancing and adjusting of the air and water systems. All test instruments should have been calibrated within the last six (6) months. Balancing Subcontractor shall provide verification of calibration upon request.

F. Architect/Engineer and Owner shall be notified a minimum of five (5A) days prior to balancing commencing so that a representative can be available to witness the balancing work. In addition, the Balancing Subcontractor shall (upon completion of the balancing work and report submittal), at the request of the Architect/Engineer or Owner's representative, verify the balancing readings at four (4) locations. The locations shall be chosen by the Architect/Engineer or Owner's representative.

G. All balancing and adjusting of air and water systems shall be done in accordance without the latest edition of the NEBB procedural Standards for Testing, Adjusting and Balancing of Environmental systems or the latest edition of SMACNA's HVAC Systems Testing, Adjusting and Balancing.

H. Balancing of the cooling systems shall be performed in the air conditioning season, heating systems in the heating season.

I. Prior to balancing of the air and water systems, and as [art of the balancing report, the Balancing subcontractor shall prepare ductwork and piping schematics of the systems to be balanced. Schematics shall be similar to those indicated in the NEBB and SMACNA publications previously identified. Piping schematics shall be of similar content to ductwork schematics.

J. Air and Water Balancing Report forms shall be similar to the standard NEBB and SMACNA forms found in the previously identified manuals. The following information shall be provided at minimum (reports for equipment and systems not indicated shall be obtained from the NEBB/SMACNA manuals or prepared by the Balancing Subcontractor. Reports prepared by the Balancing Subcontractor shall be submitted for review and approval prior to final Balancing Report submittal):

    1. Air Apparatus Test Report
        a. Location.
        b. System Number.
        c. Manufacturer.
        d. Airflow, design and actual.
        e. Total CFM.
        f. Total Static pressure.
        g. Discharge Static Pressure.
        h. Suction Static Pressure.
        i. Coil pressure drops (static pressure).
        j. Filter pressure drops.
        k. Motor volts and amps.
        l. Outside Air and Return Air CFM.
        m. Drive data.
    2. Coil Test Report
        a. system Number.
        b. Location.
        c. Manufacturer.
        d. Airflow, design and actual.

e. Entering air temperature (DW/WB), design and actual.
f. Leaving air temperature (DW/WB), design and actual.
g. Water flow GPM, design and actual.
h. Entering water temperature, design and actual.
i. Leaving water temperature, design and actual.
j. Waterside pressure drop.
k. Airside pressure drop.
a.

3. Fan Test Report
   a. System Number.
   b. Location.
   c. Manufacturer.
   d. Airflow, design and actual.
   e. Total static pressure, design and actual.
   f. Inlet static pressure.
   g. Discharge static pressure.
   h. Motor and Drive data.
   i. Fan RPM.
   j. Voltage and Amperage.

4. Duct Traverse
   a. System zone/branch.
   b. Duct Size.
   c. Area.
   d. Design Velocity.
   e. Design Airflow.
   f. Test Velocity.
   g. Test Airflow.
   h. Duct Static Pressure.
   i. Air temperature.

5. Air Outlet Report
   a. Area Served.
   b. Outlet Number.
   c. Type.
   d. Size.
   e. AK factor.
   f. Velocity, design and actual.
   g. Airflow, design and actual.
6. Pump Test Report
   a. Unit Number.
   b. Manufacturer.
   c. Motor data.
   d. Voltage and amperage data.
   e. Waterflow, design and actual.
   f. Suction Pressure.

g. Discharge Pressure.
h. Total Head Pressure

K. The Balancing Subcontractor shall balance and adjust air and water systems to meet design requirements. ± 5%. Balancing shall be accomplished by adjusting dampers, drives, valves, etc. to obtain design requirements.

L. The HVAC subcontractor shall cooperate and make provisions for the Balancing Subcontractor as needed to accommodate the air and water balancing. As part of this Contract, the HVAC Subcontractor shall provide and/or change pulleys, belts, sheaves, valves and dampers, at no additional cost, in order to properly balance the systems to design requirements.

3.23 START UP AND TESTING OF COOLING EQUIPMENT

A. All HVAC equipment must start up by manufacture rep and report shall be generated on manufactures letter head.

B. All cooling equipment shall be tested to verify that the equipment operates mechanically and electrically as specified.

C. The Contractor shall verify that all operating and safety controls are correctly adjusted.

D. The Contractor shall verify that the cooling equipment controls are operating properly.

E. Tests shall be made to verify that the capacity control is fully modulating according to the required load, and that all control valves are operating according to the specifications. Tests shall be made at minimum load, 50% load, 100% load and various other loads throughout the modulating cycle.

F. The Contractor shall record the following non-test data:

1. Equipment designation number.
2. Equipment manufacturer.
3. Model number.
4. Serial number.
5. Rated input.
6. Rated output.
7. All other pertinent data.

G. The Contractor shall perform and record the following to meet minimum requirements:

1. Verify proper system operation.
2. Verify that the cooling system controls are operating according to design specifications.
3. All other measurements required for complete system testing.

H. The Contractor shall calculate the system coefficient of performance as measured. All calculations made using the measured data shall be included in the report. In general, the Contractor shall complete all tests necessary for complete cooling system analysis.

3.24 SEQUENCES OF OPERATION

A. Boilers Sequence of Operation:

1. The heating shall be inoperative as long as the outdoor temperature is above the setting on the outdoor thermostat (supplied). When the temperature drops below this setting, (usually 65ºF), the "S" control is energized, the heating boilers and the system circulator are energized. The "S" control shall automatically fire the heating boilers as they are needed to maintain the reset water temperature to the system as dictated by outdoor temperature.
2. When the outdoor temperature reaches 65ºF (adjustable), the circulators and the "S" control is de-energized, leaving only the water heating boilers in operation.
3. The entire hot water boiler installation shall be installed in accordance with manufacturer's installation specifications.
4. The "First-on-first-off" switch on the "S" control shall allow heating models to alternate firing sequence.
5. Boilers shall be as manufactured by Hydrotherm or equal.

3.25 EXAMINATION

A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started

B. The Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started

C. The Contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate — or if any discrepancies occur between the plans and the Contractor’s work, and the plans and the work of others — the Contractor shall report these discrepancies to the Engineer and shall obtain written instructions for any changes necessary to accommodate the Contractor’s work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the Contractor to report such discrepancies shall be made by — and at the expense of — this Contractor.

3.26 PROTECTION

A. The Contractor shall protect all work and material from damage by its work or employees, and shall be liable for all damage thus caused

B. The Contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted. The Contractor shall protect any material that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects

3.27 COORDINATION

A. Site

1. Where the mechanical work will be installed in close proximity to, or will interfere with work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. If the Contractor installs its work before coordinating with other trades, so as to cause any interference with

work of other trades, the Contractor shall make the necessary changes in its work to correct the condition without extra charge
2. Coordinate and schedule work with all other work in the same area, or with work which is dependent upon other work, to facilitate mutual progress.

B. Submittals. Refer to the "Submittals" Article in Part 1 of this specification for requirements

C. Test and Balance

1. The Contractor shall furnish all tools necessary to interface to the control system for test and balance purposes
2. The Contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours
3. In addition, the Contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.
4. The tools used during the test and balance process will be returned at the completion of the testing and balancing

D. Life Safety

1. Duct smoke detectors required for air handler shutdown are supplied and installed under Division 16. The Division 16 Contractor shall interlock smoke detectors to air handlers for shutdown as described in Part 3: "Sequences of Operation".
2. Smoke dampers and actuators required for duct smoke isolation are provided under another Division 15 Section
3. Fire/smoke dampers and actuators required for fire rated walls are provided under another Division 15 Section. Control of these dampers shall be by Division 16.

E. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the Contractor as follows:

1. All communication media and equipment shall be provided as specified in Part 2: "Communication" of this specification.
2. Each supplier of controls product is responsible for the configuration, programming, start-up, and testing of that product to meet the sequences of operation described in this section.
3. The Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this Section and those provided under other sections or divisions of this specification.

3.28 FIELD QUALITY CONTROL

A. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this specification

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship

C. Contractor shall have work inspected by local and/or state/provincial authorities having jurisdiction over the work

3.29 WIRING

A. All control and interlock wiring shall comply with national and local electrical codes and Division 16 of this specification. Where the requirements of this section differ with those in Division 16, the requirements of this section shall take precedence.

B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway per NEC and Division 16 requirement.

C. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)

3.30 ACTUATORS

A. Mount and link control damper actuators per manufacturer's instructions.To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.Provide all mounting hardware and linkages for actuator installation.

B. Electric/Electronic

1. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations
2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.31 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels, shall be labelled at each end within 5 cm [2"] of termination with the DDC address or termination number.

B. Permanently label or code each point/object of field terminal strips to show the instrument or item served.

C. Identify control panels with minimum 1 cm [½”] letters on laminated plastic nameplates.

D. Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.

E. Identify room sensors relating to terminal box or valves with nameplates.

3.32 CONTROLLERS

A. Provide a separate controller for each AHU or other HVAC system.

B. Building Controllers and Advanced Application Controllers shall be selected to provide a minimum of 15% spare I/O point/object capacity for each point/object type found at each location. If input /objects are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point/object used.

1. Future use of spare capacity shall require providing the field device, field wiring, point/object database definition, and custom software. No additional controller boards or point/object modules shall be required to implement use of these spare points

3.33 PROGRAMMING

A. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free for future use.

B. Point/object Naming: System point/object names shall be modular in design, allowing easy operator interface without the use of a written point/object index. Use the following naming convention:

AAABBBCCCDDDEEE where:

AAA is used to designate the location of the point/object within the building such as mechanical room, wing, or level, or the building itself in a multi-building environment.

BBB is used to designate the mechanical system with which the point/object is associated (e.g., A01, HTG, CLG, LTG).

CCC represents the equipment or material referenced (e.g., SAF for supply air fan , EXF for exhaust fan, RAF for return air fan).

D or DD or DDD may be used for clarification or for identification if more than one of CCC exists (e.g., SAF10, EXF121).

EE represents the action or state of the equipment or medium (e.g., T for temperature, RH for humidity, CO for control, S for status, D for damper control, I for current).

C. Software Programming

1. Provide programming for the system and adhere to the sequences of operation provided. The Contractor also shall provide all other system programming necessary for the operation of the system, but not specified in this document. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:
   a. Text-based:
      i. must provide actions for all possible situations
      ii. must be modular and structured
      iii. must be commented
   b. Graphic-based
      i. must provide actions for all possible situations
      ii. must be documented
   c. Parameter-based
      i. must provide actions for all possible situations
      ii. must be documented

D. Operator Interface

1. Standard Graphics. Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air

handler, and all terminal equipment. Point/object information on the graphic displays shall dynamically update. Show on each graphic all input and output points/objects for the system. Also show relevant calculated points/objects such as setpoints

2. Sow terminal equipment information on a "graphic" summary table. Provide dynamic information for each point/object show
3. The Contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all Operator Workstation software and their functions as described in this section. This includes any operating system software, the Operator Workstation database, and any third-party software installation and integration required for successful operation of the operator interface.

3.34 CONTROL SYSTEM CHECKOUT AND TESTING

A. Start-up Testing: All testing listed in this article shall be performed by the Contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Owner's Representative is notified of the system demonstration.

1. The Contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification
2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight
3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers' recommendations
4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct
5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The Contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Contractor shall make any necessary adjustments to valve stem and damper blade travel
6. Verify that the system operation adheres to the Sequences of Operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum Start/Stop routines.
7. Alarms and Interlocks
   a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm
   b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
   c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action

3.35 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration

1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed its own tests
2. The tests described in this section are to be performed in addition to the tests that the Contractor performs as a necessary part of the installation, startup, and debugging process and as specified in the "Control System Checkout and Testing" Article in Part 3 of this specification. The Engineer will be present to observe and review these tests. The Engineer shall be notified at least 10 days in advance of the start of the testing procedures.
3. The demonstration process shall follow that approved in Part 1: "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration
4. The Contractor shall provide at least two persons equipped with two-way communication, and shall demonstrate actual field operation of each control and sensing point for all modes of

operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point/object and system. Any test equipment required to prove the proper operation shall be provided by and operated by the Contractor.

5. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
6. Demonstrate compliance with Part 1: "System Performance
7. Demonstrate compliance with Sequences of Operation through all modes of operation
8. Demonstrate complete operation of Operator Workstation
9. Additionally, the following items shall be demonstrated:

    a. DDC Loop Response. The Contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in setpoint, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the setpoint, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.
    b. Demand limiting. The Contractor shall supply a trend data output showing the action of the demand-limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting setpoint, and the status of shed-able equipment outputs.
    c. Optimum Start/Stop. The Contractor shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas
    d. Interface to the building fire alarm system
    e. Operational logs for each system that indicate all setpoints, operating points, valve positions, mode, and equipment status shall be submitted to the Architect/Engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.
    f. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The Contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

B. Acceptance

1. All tests described in this specification shall have been performed to the satisfaction of both the Engineer and Owner prior to the acceptance of the control system as meeting the requirements of Completion. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Engineer. Such tests shall then be performed as part of the warranty.
2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1: "Submittals."

3.36 CLEANING

A. The Contractor shall clean up all debris resulting from its activities daily. The Contractor shall remove all cartons, containers, crates, etc., under its control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

B.

B. At the completion of work in any area, the Contractor shall clean all of its work, equipment, etc., keeping it free from dust, dirt, and debris, etc.

C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.37 TRAINING

A. General

1. Provide a minimum of one onsite training class 8 hours in length during the construction period for personnel designated by the owner.
2. Provide two additional training sessions at 6 and 12 months following building's turnover. Each session shall be 8 hrs in length and must be coordinated with the building Owner.

B. Train the designated staff of Owner's Representative and Owner to enable Day-to-day Operators to:

1. Proficiently operate the system.
2. Understand control system architecture and configuration.
3. Understand DDC system components.
4. Understand system operation, including DDC system control and optimizing routines (algorithms).
5. Operate the workstation and peripherals.
6. Log on and off the system.
7. Access graphics, point/object reports, and logs.
8. Adjust and change system setpoints, time schedules, and holiday schedules.
9. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
10. Understand system drawings, and Operation and Maintenance manual.
11. Understand the job layout and location of control components.
12. Access data from DDC controllers and ASC.
13. Operate portable operator's terminals.

C. Train the designated staff of Owner's Representative and Owner to enable Advanced Operators to:

1. Make and change graphics on the workstation
2. Create, delete, and modify alarms, including annunciation and routing of these
3. Create, delete, and modify point/object trend logs, and graph or print these
4. Create, delete, and modify reports
5. Add, remove, and modify system's physical points/objects
6. Create, modify, and delete programming
7. Add panels when required
8. Add Operator Workstation stations
9. Create, delete, and modify system displays — both graphical and otherwise

10. Perform DDC system field checkout procedures
11. Perform DDC controller unit operation and maintenance procedures
12. Perform workstation and peripheral operation and maintenance procedures
13. Perform DDC system diagnostic procedures
14. Configure hardware including PC boards, switches, communication, and I/O points/objects
15. Maintain, calibrate, troubleshoot, diagnose, and repair hardware
16. Adjust, calibrate, and replace system components

D. Train the designated staff of Owner's Representative and Owner to enable System Managers/Administrators to:

1. Maintain software and prepare backups
2. Interface with job-specific, third-party operator software
3. Add new users and understand password security procedures

E. Provide course outline and materials as per "Submittals" Article in Part 1 of this specification. The instructor(s) shall provide one copy of training material per student.

C.

F. The instructor(s) shall be factory-trained instructors experienced in presenting this material.

G. Classroom training shall be done using a network of working controllers representative of the installed hardware.

3.38 EXECUTION

A. Verify that door frame and adjacent construction are installed and ready to receive work of this Section.

B. Verify that utilities are in correct location and are of correct capacities for specified products.

3.39 INSTALLATION

A. Install air doors where shown on Drawings and in accordance with [shop drawings and] manufacturers instructions.

B. Air doors shall be securely installed plumb, level, and as close as practical to top of opening and face of wall.

C. Install switches where indicated.

D. Connection to utilities is specified in RELATED WORK.

3.40 SYSTEM STARTUP

A. Test and operate air door to be sure that it performs as intended. Adjust discharge nozzles to deflect air outward [unless otherwise required.]

4.1 AUTOMATIC TEMPERATURE CONTROL SYSTEM

D. Approved Control System Manufacturer

1. The base bid is based on Johnson Controls or equal. Other manufacturers shall bid subject to meeting all requirements of the specification.

3.24 Part 1 – General

Table of Contents

A. Related Documents

1. All work of this Division shall be coordinated and provided by the single Building Management System (BMS) Contractor.

2. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 15 Sections for details.
3. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.
4. If the BMS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

B. Definitions

1. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.
2. Binary: A two-state system where an "ON" condition is represented by one discrete signal level and an "OFF" condition is represented by a second discrete signal level.
3. Building Management System (BMS): The total integrated system of fully operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Division BMS Contractor and to be interfaced to the associated work of other related trades.
4. BMS Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BMS work.
5. Control Sequence: A BMS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.
6. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BMS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
7. BMS Network: The total digital on-line real-time interconnected configuration of BMS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.
8. Node: A digitally programmable entity existing on the BMS network.
9. BMS Integration: The complete functional and operational interconnection and interfacing of all BMS work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent BMS as required by this Division.
10. Provide: The term "Provide" and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.
11. PC: Personal Computer from a recognized major manufacturer
12. Furnish: The term "Furnish" and its derivatives when used in this Division shall mean supply at the BMS Contractor's cost to the designated third party trade contractor for installation. BMS Contractor shall connect furnished items to the BMS, calibrate, test, commission, warrant and document.
13. Wiring: The term "Wiring" and its derivatives when used in this Division shall mean provide the BMS wiring and terminations.

14. Install: The term "Install" and its derivatives when used in this Division shall mean receive at the jobsite and mount.
15. Protocol: The term "protocol" and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BMS network nodes.
16. Software: The term "software" and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BMS industry for real-time, on-line, integrated BMS configurations.
17. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.
18. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.
19. The following abbreviations and acronyms may be used in describing the work of this Division:

ADC	-	Analog to Digital Converter
AHJ	-	Authority Having Jurisdiction
AI	-	Analog Input
AN	-	Application Node
ANSI	-	American National Standards Institute
AO	-	Analog Output

ASCII - American Standard Code for Information Interchange

ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers

AWG - American Wire Gauge

CPU	-	Central Processing Unit
CRT	-	Cathode Ray Tube
DAC	-	Digital to Analog Converter
DDC	-	Direct Digital Control
DI	-	Digital Input
DO	-	Digital Output

EEPROM - Electronically Erasable Programmable Read Only Memory

EMI	-	Electromagnetic Interference
FAS	-	Fire Alarm Detection and Annunciation System
GUI	-	Graphical User Interface
HOA	-	Hand-Off-Auto
ID	-	Identification
IEEE	-	Institute of Electrical and Electronics Engineers
I/O	-	Input/Output
IT	-	Information Technology
LAN	-	Local Area Network
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MCC	-	Motor Control Center
NC	-	Normally Closed
NIC	-	Not In Contract
NO	-	Normally Open

OWS	-	Operator Workstation
OAT	-	Outdoor Air Temperature
PC	-	Personal Computer
RAM	-	Random Access Memory
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
RH	-	Relative Humidity
ROM	-	Read Only Memory
RTD	-	Resistance Temperature Device
SPDT	-	Single Pole Double Throw
SPST	-	Single Pole Single Throw
XVGA	-	Extended Video Graphics Adapter
TBA	-	To Be Advised
TCP/IP	-	Transmission Control Protocol/Internet Protocol
TTD	-	Thermistor Temperature Device
UPS	-	Uninterruptible Power Supply
VAC	-	Volts, Alternating Current
VAV	-	Variable Air Volume
VDC	-	Volts, Direct Current
WAN	-	Wide Area Network

C. BMS Description

1. The Building Management System (BMS) shall be a complete system designed for use with the enterprise IT systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.
2. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.
3. Where necessary and as dictated elsewhere in these Specifications, Servers shall be used for the purpose of providing a location for extensive archiving of system configuration data, and historical data such as trend data and operator transactions. All data stored will be through the use of a standard data base platform: Microsoft SQL Server Express or Microsoft SQL Server as dictated elsewhere in this specification.
4. The work of the single BMS Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.
5. The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS.

6. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.
7. Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.
8. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:
    1. All control products provided for this project shall comprise a BACnet internetwork. Communication involving control components (i.e., all types of controllers and Operator Workstations) shall conform to ANSI/ASHRAE Standard 135-2001, BACnet.
    2. Each BACnet device shall operate on the BACnet Data Link/Physical layer protocol specified for that device as defined in this section.
    3. The Contractor shall provide all communication media, connectors, repeaters, bridges, hubs, switches, and routers necessary for the internetwork.
    4. All controllers shall have a communication port for connections with the Operator Workstations using the BACnet Data Link or equal Physical layer protocol.
    5. A device on the internetwork shall be provided with a 56k-baud modem that will allow for remote Operator Workstation using the BACnet PTP Data Link/ Physical layer protocol. Remote Operator Workstation via this modem shall allow for communication with any and all controllers on this network as described in Paragraph F below.
    6. Communication services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:
        a. Connection of an Operator Workstation device to any one controller on the internetwork will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the internetwork.
        b. All database values (e.g., objects, software variables, custom program variables) of any one controller shall be readable by any other controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to an object name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communication services to perform internetwork value passing.
    7. The time clocks in all controllers shall be automatically synchronized daily. An operator change to the time clock in any controller shall be automatically broadcast to all controllers on the network.
    8. The network shall have the following minimum capacity for future expansion:
        a. Each Building Controller shall have routing capacity for 99 controllers.
        b. The Building Controller network shall have capacity for 1000 Building Controllers.
        c. The system shall have an overall capacity for 12,500 Building Controller, Advanced Application Controller, and Application Specific Controller input/output objects.

D. Quality Assurance

1. General

a. The Building Management System Contractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Building Management Systems.

b. The BMS Contractor shall be a recognized national manufacturer, installer and service provider of BMS.

c. If a franchised dealer is to be considered via addendum, the dealer must provide a letter written by a minimum Vice President of Operations for the specific automatic temperature control manufacturer with the following verbiage; "should the Franchise Dealer fail to provide a complete and operational system (as judged by the owner/engineer), the Manufacturer will complete the project to the Engineer's satisfaction at no additional cost to the Owner". This letter must be provided to the engineer along with the other supporting documentation at the time of request for equivalence.

d. The BMS Contractor shall have a branch facility within a 100-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis.

e. As evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the contractor must have been in the BMS business for at least the last ten (10) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.

f. The Building Management System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Management Systems, and shall be the manufacturer's latest standard of design at the time of bid.

2. Workplace Safety and Hazardous Materials

a. Provide a safety program in compliance with the Contract Documents.

b. The BMS Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.

c. The Contractor and its employees and subtrades shall comply with federal, state and local safety regulations.

d. The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the OSHA rules that have jurisdiction for at least each topic listed in the Safety Certification Manual.

e. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.

f. Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.

g. The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.

h. The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the AHJ at the Project site.

i. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

3. Quality Management Program

a. Designate a competent and experienced employee to provide BMS Project Management. The designated Project Manger shall be empowered to make technical, scheduling and related decisions on behalf of the BMS Contractor. At minimum, the Project Manager shall:

1. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
2. Manage the financial aspects of the BMS Contract.
3. Coordinate as necessary with other trades.
4. Be responsible for the work and actions of the BMS workforce on site.

E. References

1. All work shall conform to the following Codes and Standards, as applicable:

a. National Fire Protection Association (NFPA) Standards.
b. National Electric Code (NEC) and applicable local Electric Code.
c. Underwriters Laboratories (UL) listing and labels.
d. UL 864 UUKL Smoke Control
e. UL 268 Smoke Detectors.
f. UL 916 Energy Management
g. NFPA 70 - National Electrical Code.
h. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
i. NFPA 92A and 92B Smoke Purge/Control Equipment.
j. Factory Mutual (FM).
k. American National Standards Institute (ANSI).
l. National Electric Manufacturer's Association (NEMA).
m. American Society of Mechanical Engineers (ASME).
n. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
o. Air Movement and Control Association (AMCA).
p. Institute of Electrical and Electronic Engineers (IEEE).
q. American Standard Code for Information Interchange (ASCII).
r. Electronics Industries Association (EIA).
s. Occupational Safety and Health Administration (OSHA).
t. American Society for Testing and Materials (ASTM).

u. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.

v. Americans Disability Act (ADA)

24 ANSI/ASHRAE Standard 195-2008 (BACnet)

2. In the case of conflicts or discrepancies, the more stringent regulation shall apply.
3. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

F. Work By Others

A) The demarcation of work and responsibilities between the BMS Contractor and other related trades shall be as outlined in the BMS RESPONSIBILITY MATRIX

BMS RESPONSIBILITY MATRIX				
WORK	**FURNISH**	**INSTALL**	**Low Volt. WIRING/TUBE**	**LINE POWER**
BMS low voltage and communication wiring	BMS	BMS	BMS	N/A
VAV box nodes	BMS	15	BMS	16
BMS conduits and raceway	BMS	BMS	BMS	BMS
Automatic dampers	BMS	15	N/A	N/A
Manual valves	15	15	N/A	N/A
Automatic valves	BMS	15	BMS	N/A
VAV boxes	15	15	N/A	N/A
Pipe insertion devices and taps including thermowells, flow and pressure stations.	BMS	15	BMS	BMS
BMS Current Switches.	BMS	BMS	BMS	N/A
BMS Control Relays	BMS	BMS	BMS	N/A
Power distribution system monitoring interfaces	16	16	BMS	16
Control air compressors	BMS	BMS	N/A	16
Concrete and/or inertia equipment pads and seismic bracing	15	15	N/A	N/A
BMS interface with Package RTU controls	BMS	BMS	BMS	BMS
RTU controls interface with BMS	15	15	BMS	16
BMS interface with Classroom unit controls	BMS	BMS	BMS	16
Classroom unit controls interface with BMS	15	15	BMS	16
ADD OTHER THIRD PARTY EQUIPMENT HERE	N/A	N/A	N/A	N/A
All BMS Nodes, equipment, housings, enclosures and panels.	BMS	BMS	BMS	BMS
Smoke Detectors	16	16	16	16
Fire/Smoke Dampers	15	15	BMS	16
Fire Dampers	15	15	N/A	N/A
RTU-DX Flow Switches	15	15	BMS	N/A
Boiler wiring	15	15	15	15
Water treatment system	15	15	15	16
VFDs	15	16	BMS	16

Refrigerant monitors	15	BMS	BMS	16
Computer Room A/C Unit field-mounted controls	15*	15	BMS	16
Fire Alarm shutdown relay interlock wiring	16	16	16	16
Fire Alarm smoke control relay interlock wiring	16	16	BMS	16
Fireman's Smoke Control Override Panel	16	16	16	16
Fan Coil Unit controls	BMS	BMS	BMS	16
Unit Heater controls	BMS	BMS	BMS	16
Packaged RTU space mounted controls	15*	BMS	BMS	16
Packaged RTU factory-mounted controls	15*	15	BMS	16
Packaged RTU field-mounted controls	BMS	BMS	BMS	16
Cooling Tower Vibration Switches	15	15	16	16
Cooling Tower Level Control Devices	15	15	16	16
Cooling Tower makeup water control devices	15	15	16	16
Pool Dehumidification Unit Controls	15*	15	BMS	16
Starters, HOA switches	16	16	N/A	16
Control damper actuators	BMS	BMS	BMS	16

G. Submittals

1. Shop Drawings, Product Data, and Samples
    a. The BMS contractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.
    b. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
    c. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BMS work.
    d. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.
    e. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
    f. The BMS Contractor shall correct any errors or omissions noted in the first review.
    g. At a minimum, submit the following:
        1. BMS network architecture diagrams including all nodes and interconnections.
        2. Systems schematics, sequences and flow diagrams.
        3. Points schedule for each point in the BMS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
        4. Samples of Graphic Display screen types and associated menus.

5. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
6. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
7. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
8. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address
9. Details of all BMS interfaces and connections to the work of other trades.
10. Product data sheets or marked catalog pages including part number, photo and description for all products including software.

1.8 Record Documentation

1. Operation and Maintenance Manuals
   a. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the BMS provided:
      1. Table of contents.
      2. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
      3. Manufacturers product data sheets or catalog pages for all products including software.
      4. System Operator’s manuals.
      5. Archive copy of all site-specific databases and sequences.
      6. BMS network diagrams.
      7. Interfaces to all third-party products and work by other trades.
   b. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

1.9 Warranty

1. Standard Material and Labor Warranty:
   a. Provide a one-year labor and material warranty on the BMS.
   b. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the BMS Contractor at the cost of the BMS Contractor.
   c. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during BMS Contractor’s normal business hours.

3.25 Part 2 – Products

A. General Description

1. The Building Management System (BMS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

2. The Building Management System shall consist of the following:
    a. Standalone Network Automation Engine(s)
    b. Field Equipment Controller(s)
    c. Input/Output Module(s)
    d. Local Display Device(s)
    e. Portable Operator's Terminal(s)
    f. Distributed User Interface(s)
    g. Network processing, data storage and communications equipment
    7. Other components required for a complete and working BMS

3. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.
4. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
    a. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
    b. The System shall maintain all settings and overrides through a system reboot.
5. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
6. The System shall comply with (UL) 864 (UUKL) Ninth Edition Smoke Control Listing including the UL 864 Ninth Edition Standard for Control Units and Accessories for Fire Alarm Systems.
    a. The System shall comply with the following NFPA Codes and Standards as applicable:
        1. NFPA 70 National Electrical Code
        2. NFPA 72 National Fire Alarm Code
        3. NFPA 101 Life Safety Code
        4. NFPA 90A Standard for the Installation of Air-Conditioning and Ventilation Systems
        5. NFPA 92B Guide for Smoke Management Systems in Malls, Atria, and Large Areas
    b. The System shall comply with the following International Code Council (ICC) Codes:
        1. Building Officials and code Administrators International (BOMA) model code
        2. International Conference of Building Officials (ICBO) model code

3. Southern Building Code Congress International (SBCCI) regulations

7. Acceptable Manufacturers
   1) Johnson Controls, Metasys or approved equal

B. BMS Architecture

1. Automation Network
   a. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
   b. The BMS shall network multiple user interface clients, automation engines, system controllers and application-specific controllers. Provide application and data server(s) as required for systems operation.
   c. All BMS devices on the automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
   d. Network Automation Engines (NAE) shall reside on the automation network.
   e. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.
2. Control Network
   a. Network Automation Engines (NAE) shall provide supervisory control over the control network and shall support the following communication protocols:
      1. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9
         The NAE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
         The NAE shall be tested and certified as a BACnet Building Controller (B-BC).
      2. LonWorks enabled devices using the Free Topology Transceiver (FTT-10a).
   b. Control networks shall provide either "Peer-to-Peer," Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
   c. DDC Controllers shall reside on the control network.
   d. Control network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.
   e. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
   f. The PICS shall be submitted 10 days prior to bidding.
3. Integration (as required with the existing campus system)
   a. Hardwired
      1. Analog and digital signal values shall be passed from one system to another via hardwired connections.

2. There will be one separate physical point on each system for each point to be integrated between the systems.

b. Direct Protocol (Integrator Panel)

1. The BMS system shall include appropriate hardware equipment and software to allow bi-directional data communications between the BMS system and 3rd party manufacturers' control panels. The BMS shall receive, react to, and return information from multiple building systems, including but not limited to the chillers, boilers, variable frequency drives, power monitoring system, and medical gas.
2. All data required by the application shall be mapped into the Automation Engine's database, and shall be transparent to the operator.
3. Point inputs and outputs from the third-party controllers shall have real-time interoperability with BMS software features such as: Control Software, Energy Management, Custom Process Programming, Alarm Management, Historical Data and Trend Analysis, Totalization, and Local Area Network Communications.

c. BACnet Protocol Integration - BACnet

1. The neutral protocol used between systems will be BACnet over Ethernet and comply with the ASHRAE BACnet standard 135-2008.
2. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
3. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.

C. User Interface

1. Dedicated Web Based User Interface

a. Where indicated on plans the BMS Contractor shall provide and install a personal computer for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the BMS Network Automation Engines to facilitate greater fault tolerance and reliability.

b. Dedicated User Interface Architecture – The architecture of the computer shall be implemented to conform to industry standards, so that it can accommodate applications provided by the BMS Contractor and by other third party applications suppliers, including but not limited to Microsoft Office Applications. Specifically it must be implemented to conform to the following interface standards.

1. Microsoft Internet Explorer for user interface functions
2. Microsoft Office Professional for creation, modification and maintenance of reports, sequences other necessary building management functions
3. Microsoft Outlook or other e-mail program for supplemental alarm functionality and communication of system events, and reports
4. Required network operating system for exchange of data and network functions such as printing of reports, trends and specific system summaries

c. PC Hardware – The personal computer(s) shall be configured as follows:

1. Memory – 1 GB (512 MB Minimum)
2. CPU– Pentium 4 processor. 2.8 GHz Clock Speed (2.0 GHz minimum)
3. Hard Drive – 80 GB free hard drive space (40GB minimum)
4. Hard drive backup system – CD/RW, DVD/RW or network backup software provided by IT department
5. CD ROM Drive – 32X performance
6. Ports – (2) Serial and (1) parallel, (2) USB ports
7. Keyboard – 101 Keyboard and 2 Button Mouse
8. CRT configuration – 1-2 CRTs as follows:

```
Each Display – 17″ Flat Panel Monitor 1280 x 1024
     resolution minimum
16 bit or higher color resolution
Display card with multiple monitor support
```

9. LAN communications – Ethernet communications board; 3Comm or equal

d. Operating System Software

1. Windows XP Professional or Windows 7 (32 bit)
2. Where user interface is not provided via browser, provide complete operator workstation software package, including any hardware or software keys. Include the original installation disks and licenses for all included software, device drivers, and peripherals.
3. Provide software registration cards to the Owner for all included software.

e. Peripheral Hardware

1. Reports printer:

```
Printer Make – Hewlett Packard DeskJet
Print Speed – 600 DPI Black, 300 DPI Color
Buffer – 64 K Input Print Buffer
Color Printing – Include Color Kit
```

2. Distributed Web Based User Interface

a. All features and functions of the dedicated user interface previously defined in this document shall be available on any computer connected directly or via a wide area or virtual private network (WAN/VPN) to the automation network and conforming to the following specifications.

b. The software shall run on the Microsoft Internet Explorer (6.0 or higher) browser supporting the following functions:

```
Configuration
Commissioning
Data Archiving
Monitoring
Commanding
System Diagnostics
```

c. Minimum hardware requirements:

```
1GB RAM
2.0 GHz Clock Speed Pentium 4 Microprocessor
100 GB Hard Drive.
1 Keyboard with 83 keys (minimum).
SVGA 1024x768 resolution display with 64K colors and 16
     bit color depth
```

Mouse or other pointing device

3. Site Management User Interface Application Components
    a. Operator Interface
        1. An integrated browser based client application shall be used as the user operator interface program.
        2. The System shall employ an event-driven rather than a device polling methodology to dynamically capture and present new data to the user.
        3. All Inputs, Outputs, Setpoints, and all other parameters as defined within Part 3, shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.
        4. The user interface software shall provide help menus and instructions for each operation and/or application.
        5. The system shall support customization of the UI configuration and a home page display for each operator.
        6. The system shall support user preferences in the following screen presentations:
           Alarm
           Trend
           Display
           Applications
        7. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.
        8. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
           User access for selective information retrieval and control command execution
           Monitoring and reporting
           Alarm, non-normal, and return to normal condition annunciation
           Selective operator override and other control actions
           Information archiving, manipulation, formatting, display and reporting
           BMS internal performance supervision and diagnostics
           On-line access to user HELP menus
           On-line access to current BMS as-built records and documentation
           Means for the controlled re-programming, re-configuration of BMS operation and for the manipulation of BMS database information in compliance with the prevailing codes, approvals and regulations for individual BMS applications
        9. The system shall support a list of application programs configured by the users that are called up by the following means:
           The Tools Menu
           Hyperlinks within the graphics displays
           Key sequences
        10. The operation of the control system shall be independent of the user interface, which shall be used for operator communications only. Systems

that rely on an operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.

b. Navigation Trees

1. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.
2. Provide the ability for the operator to add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.
3. The navigation trees shall be "dockable" to other displays in the user interface such as graphics. This means that the trees will appear as part of the display, but can be detached and then minimized to the Windows task bar. A simple keystroke will reattach the navigation to the primary display of the user interface.

c. Alarms

1. Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
   Log date and time of alarm occurrence.
   Generate a "Pop-Up" window, with audible alarm, informing a user that an alarm has been received.
   Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
   Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
   Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
   Any attribute of any object in the system may be designated to report an alarm.
2. The BMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions.
3. The BMS shall allow a minimum of 4 categories of alarm sounds customizable through user defined wav.files.
4. The BMS shall annunciate application alarms at minimum, as required by Part 3.

d. Reports and Summaries

1. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:

```
All points in the BMS
All points in each BMS application
All points in a specific controller
All points in a user-defined group of points
All points currently in alarm
All points locked out
All user defined and adjustable variables, schedules,
     interlocks and the like.
```

2. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.
3. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.
4. Provide the capability to view, command and modify large quantities of similar data in tailored summaries created online without the use of a secondary application like a spreadsheet. Summary definition shall allow up to seven user defined columns describing attributes to be displayed including custom column labels. Up to 100 rows per summary shall be supported. Summary viewing shall be available over the network using a standard Web browser.
5. Provide a focused set of reports that includes essential information required for effective management of energy resources within the facility. Energy reports shall be configurable from predefined, preconfigured templates. Required includes but shall not be limited to:
   Energy Overview
   Load Profile
   Simple Energy Cost
   Consumption
   Equipment Runtime
   Electrical Energy
   Energy Production

   Reports shall be selectable by date, time, area and device. Each report shall include a color visual summary of essential energy information.

e. Schedules

1. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
   ```
   Weekly schedules
   Exception Schedules
   Monthly calendars
   ```
2. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
3. It shall be possible to define one or more exception schedules for each schedule including references to calendars
4. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the exception schedules.
5. Changes to schedules made from the User Interface shall directly modify the Network Automation Engine schedule database.

6. Schedules and Calendars shall comply with ASHRAE SP135/2008 BACnet Standard.
7. Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.
8. Software shall be provided to configure and implement optimal start and stop programming based on existing indoor and outdoor environmental conditions as well as equipment operating history

f. Password

1. Multiple-level password access protection shall be provided to allow the user/manager to user interface control, display, and database manipulation capabilities deemed appropriate for each user, based on an assigned password.
2. Each user shall have the following: a user name (accept 24 characters minimum), a password (accept 12 characters minimum), and access levels.
3. The system shall allow each user to change his or her password at will.
4. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
5. A minimum of six levels of access shall be supported individually or in any combination as follows:

```
Level 1 = View Data
Level 2 = Command
Level 3 = Operator Overrides
Level 4 = Database Modification
Level 5 = Database Configuration
Level 6 = All privileges, including Password Add/Modify
```

6. A minimum of 100 unique passwords shall be supported.
7. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
8. Operators shall be further limited to only access, command, and modify those buildings, systems, and subsystems for which they have responsibility. Provide a minimum of 100 categories of systems to which individual operators may be assigned.
9. The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.

g. Screen Manager

1. The User Interface shall be provided with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum of 4 active display windows plus a network or user defined navigation tree.

h. Dynamic Color Graphics

1. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.
2. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed.
   The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.
3. Graphics runtime functions – A maximum of 16 graphic applications shall be able to execute at any one time on a user interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:
   All graphics shall be fully scalable
   The graphics shall support a maintained aspect ratio.
   Multiple fonts shall be supported.
   Unique background shall be assignable on a per graphic basis.
   The color of all animations and values on displays shall indicate the status of the object attribute.
   Graphics that represent buildings or systems shall allow natural links and transitions between related detailed tabular views of data that compliment the graphic.
4. Operation from graphics – It shall be possible to change values (setpoints) and states in system controlled equipment directly from the graphic.
5. Floor Plan graphics – The user interface shall provide graphic applications that summarize conditions on a floor. Floor plan graphics shall indicate thermal comfort using dynamic colors to represent zone temperature deviations from zone setpoint(s). Floor plan graphics shall display overall metrics for each zone in the floor.
6. Aliasing – Many graphic displays representing part of a building and various building components are exact duplicates, with the exception that the various variables are bound to different field values. Consequently, it shall be possible to bind the value of a graphic display to aliases, as opposed to the physical field tags.
7. Graphic editing tool – A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all animations, and defining all runtime binding.
   The graphic editing tool shall provide a library of standard HVAC equipment, floor plan, lighting, security and network symbols.
   The graphic editing tool shall provide for the creation and positioning of library symbols by dragging from tool bars or drop-downs and positioning where required.
   The graphics editing tool shall permit the importing of AutoCAD drawings for use in the system.

The graphic editing tool shall be able to add additional content to any graphic by importing images in the SVG, PNG or JPG file formats.

8.

i. Historical trending and data collection

1. Each Automation Engine shall store trend and point history data for all analog and digital inputs and outputs, as follows:

Any point, physical or calculated, may be designated for trending. Two methods of collection shall be allowed:

Defined time interval
Upon a change of value

Each Automation Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.

2. The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in SQL database format.

j. Trend data viewing and analysis

1. Provide a trend viewing utility that shall have access to all database points.
2. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.
3. The trend viewing utility shall have the capability to define trend study displays to include multiple trends
4. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.
5. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.
6. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.
7. The Display shall support the user's ability to change colors, sample sizes, and types of markers.

k. Database Management

1. Where a separate SQL database is utilized for information storage the System shall provide a Database Manager that separates the database monitoring and managing functions by supporting two separate windows.
2. Database secure access shall be accomplished using standard SQL authentication including the ability to access data for use outside of the Building Automation application.
3. The database managing function shall include summarized information on trend, alarm, event, and audit for the following database management actions:

Backup
Purge
Restore

4. The Database Manager shall support four tabs:

Statistics – shall display Database Server information and Trend, Alarm (Event), and Audit information on the Metasys Databases.
Maintenance – shall provide an easy method of purging records from the Metasys Server trend, alarm (event), and audit databases by supporting separate screens for creating a backup prior to purging, selecting the database, and allowing for the retention of a selected number of day's data.
Backup – Shall provide the means to create a database backup file and select a storage location.
Restore – shall provide a restricted means of restoring a database by requiring the user to log into an Expert Mode in order to view the Restore screen.

5. The Status Bar shall appear at the bottom of all Metasys Database Manager Tabs and shall provide information on the current database activity. The following icons shall be provided:
Ready
Purging Record from a database
Action Failed
Refreshing Statistics
Restoring database
Shrinking a database
Backing up a database
Resetting internet information Services
Starting the Metasys Device Manager
Shutting down the Metasys Device Manager
Action successful
6. The Database Manager monitoring functions shall be accessed through the Monitoring Settings window and shall continuously read database information once the user has logged in.
7. The System shall provide user notification via taskbar icons and e-mail messages when a database value has exceeded a warning or alarm limit.
8. The Monitoring Settings window shall have the following sections:
General – Shall allow the user to set and review scan intervals and start times.
Email – Shall allow the user to create and review e-mail and phone text messages to be delivered when a Warning or Alarm is generated.
Warning – shall allow the user to define the Warning limit parameters, set the Reminder Frequency, and link the e-mail message.
Alarm – shall allow the user to define the Alarm limit parameters, set the Reminder Frequency, and link the e-mail message.
Database login – Shall protect the system from unauthorized database manipulation by creating a Read Access and a Write Access for each of the Trend, Alarm (Event) and Audit databases as well as an Expert Mode required to restore a database.
9. The Monitoring Settings Taskbar shall provide the following informational icons:
Normal – Indicates by color and size that all databases are within their limits.

Warning - Indicates by color and size that one or more databases have exceeded their Warning limit.
Alarm - Indicates by color and size that one or more databases have exceeded their Alarm limit.

10. The System shall provide user notification via Taskbar icons and e-mail messages when a database value has exceeded a warning or alarm limit.

l. Demand Limiting and Load Rolling

1. The System shall provide a Demand Limiting and Load Rolling program for the purpose of limiting peak energy usage and reducing overall energy consumption.
2. The System shall support both Sliding Window and Fixed Window methods of predicting demand.
3. The System shall support three levels of sensitivity in the Sliding Window demand calculations for fine tuning the system.
   Low Setting – Sheds loads later and over the shortest amount of time. Maximizes the time the equipment is on.
   Medium Setting – Sheds loads earlier over a longer amount of time than the Low Setting. Increases the time the equipment is on and decreases the probability of exceeding the Tariff Target over the Low Setting.
   High Setting – Sheds loads earlier over a longer amount of time than the Medium Setting. Minimizes the probability of exceeding the Tariff Target.
4. The System shall have both a Shed Mode and a Monitor Only Mode of operation.
   When the Shed Mode is engaged, the System shall actively control the Demand.
   When the Monitor Mode is engaged, the System will simulate the shedding action but will not take any action.
5. The Demand Limiting program shall monitor the energy consumption rate and compare it to a user defined Tariff Target. The system shall maintain consumption below the target by selectively shedding loads based upon a user defined strategy.
6. The Demand Limiting program shall be capable of supporting a minimum of 10 separate Load Priorities. Each load shall be user assigned to a Load Priority.
7. The Demand Limiting program shall be capable of supporting a minimum of 12 separate Tariff Targets defining the maximum allowed average power during the current interval.
8. The System shall support a Maximum Shed Time for each load as determined by the user. The system shall restore the load before the Maximum Shed time has expired.
9. The System shall support a Minimum Shed Time for each load as determined by the user. The system shall not restore the load sooner than the Minimum Shed Time has expired.
10. The System shall support a Minimum Release Time for each load as determined by the user. The System shall not shed the load until it has been off for the Minimum Release time.

11. The System shall support three user defined options if the meter goes unreliable.
    Shedding – The currently shed loads will be released as their Maximum shed Times expire.
    Maintain the Current Shed Rate – The System will use the Demand Limiting shed rate that was present when the meter went unreliable.
    Use Unreliable Meter Shed Rate – the system will control to a user defined Unreliable Shed Rate target.
12. The Load Rolling program shall sum the loads currently shed and compare it to a user defined Load Rolling Target. The system shall maintain consumption below the target by selectively shedding loads based upon a user defined Load Priority.
13. The Load Rolling program shall be capable of supporting a minimum of 10 separate Load Priorities. Each load shall be user assigned to a Load Priority.
14. The Load Rolling program shall be capable of supporting a minimum of 12 separate Tariff Targets defining the amount of power by which the demand must be reduced.
15. The System shall provide the user with a Load Tab that displays all of the Demand Limiting and Load Rolling parameters for any selected load.
16. The System shall provide the user with a Load Summary that displays all of the loads associated with the Demand Limiting and Load Rolling programs. Status Icons for each load shall indicate:
    Load is Offline
    Load is Disabled
    Load is Shed
    Load is Locked
    Load is in Comfort Override
17. The Load Summary shall include a Load Summary Runtime view listing the following load conditions:
    Load Priority
    Shed Strategy
    Load Rating
    Present Value
    Ineligibility Status
    Active Timer
    Time Remaining
    Last Shed Time

4. Portable Operator Terminal
    a. For systems that do not provide full access to systems configuration and definition via the Browser Based user interface the BMS Contractor shall provide a portable operator terminal for programming purposes. The terminal shall be configured as follows:
        1. Personal Laptop Computer Manufacturer – Dell, Compaq or HP
        2. 1 GB RAM (256 MB minimum) – XP Professional
        3. 1.8 GHz Clock Speed Pentium 4 Microprocessor (800 MHz minimum)
        4. 40 GB Hard Drive (40 GB minimum)
        5. (1) CD-ROM Drive, 32x speed

6. (1) Serial (1) Parallel (2) USB ports
7. 1 Keyboard with 83 keys (minimum).
8. Integral 2 button Track Point or Track Ball.
9. 10" SVGA 1024x768 resolution color display
10. Two PCMCIA Type II or one Type III card slot
11. Complete operator workstation software package, including any hardware or software.
12. Original printed manuals for all software and peripherals.
13. Original installation disks or CD for all software, device drivers, and peripherals
14. Software registration cards for all included software shall be provided to the Owner.
15. Carrying case
16. Spare battery.
17. External power supply/battery charger

b. Proprietary Portable Terminal

1. Manufacturers providing proprietary portable terminals shall submit technical data sheets for the terminal and all associated software and hardware.
2. The proprietary terminal shall meet the same operator interface software requirements as specified above.

c. Software

1. Portable operator terminals shall support all controllers within the system on a direct-connect communications basis.
2. When used to access First or Second Tier controllers, the portable operator terminal shall utilize the standard operator workstation software, as previously defined.
3. When used to access Application Specific Controllers, the portable operator terminal shall utilize either the standard operator workstation software, as previously defined, or controller-specific utility software.

5. Ready Access Portal User Interface

a. BMS Contractor shall provide and install all computer hardware and software required for the purpose of configuration and consolidation of information and programs required for the delivery of a Task Focused, Web Based Portal to the BMS. This Ready Access Portal shall provide a natural, complementary extension to the Metasys site management user interface previously described.

b. Ready Access Portal Architecture – The architecture of the system shall be implemented to conform to industry standards, so that it can accommodate the required applications provided by the BMS Contractor as well as communicate information too and from the Metasys system Site Director.

c. PC Hardware – The personal computer(s) shall be configured as follows if a server is not being provided because it is not needed for integration:

1. Memory – 2 GB (1 GB Minimum)
2. CPU– Pentium 4 processor. 2.8 Hz Clock Speed (2.0 GHz minimum)
3. Hard Drive – 200 GB free hard drive space (80 GB minimum)

4. Hard drive backup system – CD/RW, DVD/RW or network backup software provided by IT department
5. DVD ROM Drive – 16X performance
6. Ports – (1) Serial, (2) USB ports
7. Keyboard – 101 Keyboard and 2 Button Mouse
8. CRT configuration
   17″ Flat Panel Monitor 1280 x 1024 resolution minimum 16 bit or higher color resolution
9. LAN communications – Ethernet communications board; 100Mbps Min.

d. Operating System Software if a server is not being provided because it is not needed for integration

1. Windows XP Professional, IIS Version 5.1, .Net Version 2.0, SQL server 2005 Express software with SP2 or <Alternately> Microsoft Windows Server 2003 OS with SP2, IIS Version 6.0, .Net version 2.0 and SQL Server 2005 with SP@
2. Provide required software and hardware required for for integration of computing hardware on enterprise IT network.
3. Provide software registration cards to the Owner for all included software.

e. User Interface Application Components

1. The ready access portal shall provide an intuitive user interface to key Metasys functions and tasks via web browser.
2. Plug-ins or special software shall not be required for access to alarm, summary, schedule and trend data.
3. The portal shall include the ability to view full graphical representations of systems and equipment on PC platforms
4. The control system shall provide Secure Sockets Level (SSL) and Active Directory service support. If the Active Directory service and Single Sign-On features are enabled and the user is logged in to the Windows desktop, the login screen does not appear and access to the system is automatic.
5. Provide a common tool for graphics creation, schedule creation, custom programming, user access and hardware definition
6. Information shall be accessible on both personal computer and handheld device platforms as follows:
   Personal computers – Internet Explorer Version 7.0 recommended
   Handheld devices – Internet Explorer for Window Mobile Version 5.0 or 6.0 recommended, as well as Apple i-Phone, i-Touch, or i-Pad. UI is optimized for devices with a 240 x 320 pixel screen size (QVGA).

f. Operator Interface

1. Password access shall be as described previously for management portal UI
2. Once logged in, the System shall display a pre-selected screen tailored to the task requirements of the individual user.
3. The User Interface shall utilize an intuitive navigation and display method designed for operators who access the system for casual information and control or on an infrequent basis. It shall feature three basic components.

Radio buttons for selection of the type of information to be displayed including Alerts, Summary, Schedules and Diagnostics
Navigation tree for selection of the specific data to be displayed on screen for the selected type. The navigation tree may be hidden and expanded by the operator to optimize the display of information
A display window that provides the selected information by type in a pre-configured tabular format

4. The user interface software shall provide help menus and instructions for each operation and/or application.
5. The system shall provide support for up to 100 concurrent users from an unlimited universe individuals with defined password access to the system
6. The system shall utilize Secure Sockets Level (SSL) support as required to allow the ready access portal to communicate across a network in a way designed to prevent eavesdropping, tampering, and message forgery. It provides endpoint authentication and communications privacy over the network using cryptography
7. The system shall have the capability to display multiple navigation trees that correspond to the user views configured in the management portal UI.
8. The alert summary of the ready access portal shall, at the minimum, provide the following information
   Alert (Alarm) type
   Date and time of alert occurrence
   Priority (color coded to level)
   Item name.
   Item value (if applicable)
   Message
   Any attribute of any object in the system may be designated to report an alarm
9. A standard summary on the ready access portal shall, at the minimum, provide the following information
   Point type graphic icon
   Item name
   Item value
   Item status
   Access to the Change Value window (if applicable) for the purpose of setting, holding or releasing an item value
10. A custom summary on the ready access portal shall display user-specified summaries of key data sets that can be quickly filtered and sorted. Items within these custom summaries can be commanded.
11. A graphic view on the ready access portal shall display as described previously for management portal UI.
12. The schedule detail summary of the ready access portal shall, at the minimum, provide the following information
    Scheduled occurrences including time and value
    Scheduled overrides including start time, end time and value
    A list of all scheduled items including name and attribute, value, status and priority

Access to the Add Temporary Override window for the purpose of adding a temporary override to the schedule

13. The diagnostic (trend) summary of the ready access portal as viewed on a personal computing device shall provide the following information.
Item name
Item status
Trend name
Trend status
Full path name
Access to trend detail summary including trended value, time and date arranged in a user selectable format of 1 hour, 12 hours, 24 hours, 48 hours or 72 hours

D. Network Automation Engines (NAE)

1. Network Automation Engine

a. The Network Automation Engine (NAE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.

b. Automation network – The NAE shall reside on the automation network and shall support a subnet of system controllers.

c. User Interface – Each NAE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.

1. The web based UI software shall be imbedded in the NAE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
2. The NAE shall support a minimum of two (2) concurrent users, unless current system requires additional users.
3. The web based user shall have the capability to access all system data through one NAE.
4. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one NAE.
5. Systems that require the user to address more than one NAE to access all system information are not acceptable.
6. The NAE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NAE.
7. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
8. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:
Configuration
Commissioning
Data Archiving
Monitoring
Commanding

System Diagnostics

9. Systems that require workstation software or modified web browsers are not acceptable.
10. The NAE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.

d. Processor – The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.

e. Memory – Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.

f. Hardware Real Time Clock – The NAE shall include an integrated, hardware-Based, real-time clock.

g. The NAE shall include troubleshooting LED indicators to identify the following conditions:

1. Power - On/Off
2. Ethernet Traffic – Ethernet Traffic/No Ethernet Traffic
3. Ethernet Connection Speed – 10 Mbps/100 Mbps
4. FC Bus – Normal Communications/No Field Communications
5. Peer Communication – Data Traffic between NAE Devices
6. Run – NAE Running/NAE in Startup/NAE Shutting Down/Software Not Running
7. Bat Fault – Battery Defective, Data Protection Battery Not Installed
8. Fault – General Fault

h. Communications Ports – The NAE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.

1. USB port
2. URS-232 serial data communication port
3. RS-485 port
4. Ethernet port

i. Diagnostics – The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

j. Power Failure – In the event of the loss of normal power, The NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

1. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.

2. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

k. Certification – The NAE shall be listed by Underwriters Laboratories (UL).

l. Controller network – The NAE shall support the following communication protocols on the controller network:

1. The NAE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.

```
The NAE shall be BACnet Testing Labs (BTL) certified
     and carry the BTL Label.
The NAE shall be tested and certified as a BACnet
     Building Controller (B-BC).
A BACnet Protocol Implementation Conformance Statement
     shall be provided for the NAE.
The Conformance Statements shall be submitted 10 days
     prior to bidding.
The NAE shall support a minimum of 50 control devices.
```

2. The NAE shall support LonWorks enabled devices using the Free Topology Transceiver FTT10.

```
All LonWorks controls devices shall be LonMark
     certified.
The NAE shall support a minimum of 64 LonWorks enabled
     control devices.
```

E. Network Control Engine

a. The Network Control Engine (NCE) shall be a fully user-programmable, supervisory controller. The NCE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.

b. The Network Control Engine (NCE) shall be a fully user-programmable, digital controller that includes a minimum of 33 I/O points, and should include more if additional are required.

c. Automation Network – The NCE shall reside on the automation network and shall support a subnet of 32 Field controllers.

d. User Interface – Each NCE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.

1. The web based UI software shall be imbedded in the NCE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
2. The NCE shall support a minimum of two (2) concurrent users.
3. The NCE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NCE.
4. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
5. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:

```
Configuration
```

```
Commissioning
Data Archiving
Monitoring
Commanding
System Diagnostics
```

6. Systems that require workstation software or modified web browsers are not acceptable.
7. The NCE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.

e. The NCE shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.

f. The NCE shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only, shall not be acceptable.

g. The NCE shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

h. The NCE shall support the following number and types of inputs and outputs:

1. Ten Universal Inputs - shall be configured to monitor any of the following:
```
Analog Input, Voltage Mode
Analog Input, Current Mode
Analog Input, Resistive Mode
Binary Input, Dry Contact Maintained Mode
Binary Input, Pulse Counter Mode
```
2. Eight Binary Inputs - shall be configured to monitor either of the following:
```
Dry Contact Maintained Mode
Pulse Counter Mode
```
3. Four Analog Outputs - shall be configured to output either of the following
```
Analog Output, Voltage Mode
Analog Output, Current Mode
```
4. Seven Binary Outputs - shall output the following:
```
24 VAC Triac
```
5. Four Configurable Outputs - shall be configured to output either of the following:
```
Analog Output, Voltage Mode
Binary Output, 24 VAC Triac Mode
```

i. The NCE shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).

1. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
2. The SA Bus shall support a minimum of 10 devices.
3. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the NCE and the furthest connected device.

j. The NCE shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the Field Trunk or the SA Bus.

k. The NCE shall support, but not be limited to, the following applications:

1. Central Equipment including chillers and boilers
2. Lighting and electrical distribution
3. Built-up air handling units for special applications
4. Power generation and energy monitoring equipment
5. Interfaces to security and fire detection systems

l. The NCE shall support a Local Controller Display (DIS1710) either as an integral part of the NCE or as a remote device communicating over the SA Bus.

1. The Display shall use a BACnet Standard SSPC-135, clause 9 Master-Slave/Token-Passing protocol.
2. The Display shall allow the user to view monitored points without logging into the system.
3. The Display shall allow the user to view and change setpoints, modes of operation, and parameters.
4. The Display shall provide password protection with user adjustable password timeout.
5. The Display shall be menu driven with separate paths for:
   `Input/Output`
   `Parameter/Setpoint`
   `Overrides`
6. The Display shall use easy-to-read English text messages.
7. The Display shall allow the user to select the points to be shown and in what order.
8. The Display shall support a back lit Liquid Crystal Display (LCD) with adjustable contrast and brightens and automatic backlight brightening during user interaction.
9. The display shall be a minimum of 4 lines and a minimum of 20 characters per line
10. The Display shall have a keypad with no more than 6 keys.
11. The Display shall be panel mountable.

m. The NCE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NCE size and capability shall be sufficient to fully meet the requirements of this Specification.

n. The NCE shall employ an industrial single board computer.

o. Each NCE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.

p. The NCE shall include an integrated, hardware-based, real-time clock.

q. The NCE shall employ nonvolatile Flash memory to store all programs and data. The NCE shall employ a data protection battery to save data and power the real time clock when primary power is interrupted.

r. The NCE shall provide removable, color coded, screw terminal blocks for 24 VAC power, communication bus and I/O point field wiring.

s. The NCE shall include troubleshooting LED indicators to identify the following conditions:

1. Power

2. Fault
3. SA Bus
4. FC Bus
5. Battery Fault
6. Ethernet
7. 10 LNK
8. 100 LNK
9. Run
10. Peer Com

t. Communications Ports – The NCE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.

1. USB port
2. RS-232 serial data communication port
3. RS-485 port
4. RJ-45 Ethernet port
5. RJ-12 jack

u. Diagnostics – The NCE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Control Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

v. Power Failure – In the event of the loss of normal power, The NCE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

1. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
2. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

w. Certification – The NCE shall be listed by Underwriters Laboratories (UL).File E107041, CCN PAZX, UL 916, Energy Management Equipment. FCC Compliant to CFR47, Part 15, Subpart B, Class A

x. Field Controller Bus – The NCE shall support the following communication protocols on the Field Controller Bus:

1. The NCE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.

```
The NCE shall be BACnet Testing Labs (BTL) certified
     and carry the BTL Label.
The NAE shall be tested and certified as a BACnet
     Building Controller (B-BC).
A BACnet Protocol Implementation Conformance Statement
     shall be provided for the NCE.
The Conformance Statements shall be submitted 10 days
     prior to bidding.
The NCE shall support a minimum of 32 control devices.
```

2. The NCE shall support LonWorks enabled devices using the Free Topology Transceiver FTT10 on the Field Controller Bus (LonWorks Network).
   All LonWorks controls devices shall be LonMark certified.
   The NCE shall support a minimum of 32 LonWorks enabled control devices.

F. DDC System Controllers

1. Field Equipment Controller

   a. The Field Equipment Controller (FEC), where applicable, shall be mounted by the equipment manufacturer and shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.

      1. The FEC shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
         The FEC shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
         The FEC shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
         A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.
         The Conformance Statement shall be submitted 10 days prior to bidding.

   b. The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.

   c. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

      .

   d. The FEC shall include troubleshooting LED indicators to identify the following conditions:

      1. Power On
      2. Power Off
      3. Download or Startup in progress, not ready for normal operation
      4. No Faults
      5. Device Fault
      6. Field Controller Bus - Normal Data Transmission
      7. Field Controller Bus - No Data Transmission
      8. Field Controller Bus - No Communication
      9. Sensor-Actuator Bus - Normal Data Transmission
      10. Sensor-Actuator Bus - No Data Transmission
      11. Sensor-Actuator Bus - No Communication

e. The FEC shall accommodate the direct wiring of analog and binary I/O field points.

f. The FEC shall support the following types of inputs and outputs:

1. Universal Inputs - shall be configured to monitor any of the following:
```
Analog Input, Voltage Mode
Analog Input, Current Mode
Analog Input, Resistive Mode
Binary Input, Dry Contact Maintained Mode
Binary Input, Pulse Counter Mode
```
2. Binary Inputs - shall be configured to monitor either of the following:
```
Dry Contact Maintained Mode
Pulse Counter Mode
```
3. Analog Outputs - shall be configured to output either of the following
```
Analog Output, Voltage Mode
Analog Output, current Mode
```
4. Binary Outputs - shall output the following:
```
24 VAC Triac
```
5. Configurable Outputs - shall be capable of the following:
```
Analog Output, Voltage Mode
Binary Output Mode
```

g. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).

1. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
2. The FC Bus shall support communications between the FECs and the NAE.
3. The FC Bus shall also support Input/Output Module (IOM) communications with the FEC and with the NAE.
4. The FC Bus shall support a minimum of 100 IOMs and FECs in any combination.
5. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.

h. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).

1. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard Protocol SSPC-135, Clause 9.
2. The SA Bus shall support a minimum of 10 devices per trunk.
3. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.

i. The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.

G. Field Devices

1. Input/Output Module

a. If required, the Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.

b. The IOM shall communicate with the FEC over the FC Bus or the SA Bus.

c. The IOM shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.

1. The IOM shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
2. The IOM shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
3. A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.
4. The Conformance Statement shall be submitted 10 days prior to bidding.

d. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

e. The IOM shall have a minimum of 4 points to a maximum of 17 points.

f. The IOM shall support the following types of inputs and outputs:

1. Universal Inputs - shall be configured to monitor any of the following:
```
Analog Input, Voltage Mode
Analog Input, Current Mode
Analog Input, Resistive Mode
Binary Input, Dry Contact Maintained Mode
Binary Input, Pulse Counter Mode
```
2. Binary Inputs - shall be configured to monitor either of the following:
```
Dry Contact Maintained Mode
Pulse Counter Mode
```
3. Analog Outputs - shall be configured to output either of the following
```
Analog Output, Voltage Mode
Analog Output, current Mode
```
4. Binary Outputs - shall output the following:
```
24 VAC Triac
```
5. Configurable Outputs - shall be capable of the following:
```
Analog Output, Voltage Mode
Binary Output Mode
```

g. The IOM shall include troubleshooting LED indicators to identify the following conditions:

1. Power On
2. Power Off
3. Download or Startup in progress, not ready for normal operation
4. No Faults
5. Device Fault
6. Normal Data Transmission
7. No Data Transmission
8. No Communication

2. VAV Modular Assembly

a. The VAV Modular Assembly shall be mounted by the VAV box manufacturer and provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall address both single and dual duct applications.

b. The VMA shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
   1. The VMA shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
   2. A BACnet Protocol Implementation Conformance Statement shall be provided for the VMA.
   3. The Conformance Statement shall be submitted 10 days prior to bidding.

c. The VAV Modular Assembly shall communicate over the FC Bus using BACnet Standard protocol SSPC-135, Clause 9.

d. The VAV Modular Assembly shall have internal electrical isolation for AC power, DC inputs, and MS/TP communications. An externally mounted isolation transformer shall not be acceptable.

e. The VAV Modular Assembly shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.

f. The VAV Modular Assembly shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

g. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.

h. The controller shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.

i. Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.

j. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.

k. Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.

l. The controller shall provide the ability to download and upload VMA configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.

m. Control setpoint changes initiated over the network shall be written to VMA non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.

n. The controller firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.

o. The controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.

p. The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain (“K” factor), and the ability to directly

command the airflow control loop to the box minimum and maximum airflow setpoints.

q. Controller performance shall be self-documenting via on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop's sample interval, which may be used to continuously monitor and document system performance. The VMA shall calculate exponentially weighted moving averages (EWMA) for each of the following. These metrics shall be available to the end user for efficient management of the VAV terminals.

```
Absolute temperature loop error
Signed temperature loop error
Absolute airflow loop error
Signed airflow loop error
Average damper actuator duty cycle
```

r. The controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:

```
Unreliable space temperature sensor
Unreliable differential pressure sensor
Starved box
Actuator stall
Insufficient cooling
Insufficient heating
```

The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The VMA would also provide a method to calculate actuator duty cycle as an indicator of damper actuator runtime.

s. The controller shall provide a compliant interface for ASHRAE Standard 62-1989 (indoor air quality), and shall be capable of resetting the box minimum airflow Based on the percent of outdoor air in the primary air stream.

t. The controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.

u. Inputs:

1. Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:

```
0-10 VDC Sensors
1000ohm RTDs
NTC Thermistors
```

2. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."
3. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.
4. Provide side loop application for humidity control.

v. Outputs

1. Analog outputs shall provide the following control outputs:

```
0-10 VDC
```

2. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.

3. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.

w. Application Configuration

1. The VAV Modular Assembly shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.

x. Sensor Support

1. The VAV Modular Assembly shall communicate over the Sensor-Actuator Bus (SA Bus) with a Network Sensor.
2. The VMA shall support an LCD display room sensor.
3. The VMA shall also support standard room sensors as defined by analog input requirements.
4. The VMA shall support humidity sensors defined by the AI side loop.

3. Network Sensors

a. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:

1. Zone Temperature
2. Zone Humidity
3. Zone Setpoint
4. Discharge Air Temperature
5. Zone CO2

b. The NS shall transmit the information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.

c. The NS shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.

1. The NS shall be tested and certified as a BACnet Smart Sensors (B-SS).
2. A BACnet Protocol Implementation Conformance Statement shall be provided for the NS.
3. The Conformance Statement shall be submitted 10 days prior to bidding.

d. The Network Zone Temperature Sensors shall include the following items:

1. A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint
2. An LED to indicate the status of the Override feature
3. A button to toggle the temperature display between Fahrenheit and Celsius
4. A button to program the display for temperature or humidity
5. A button to initiate a timed override command
6. Available in either surface mount, wall mount, or flush mount
7. Available with either screw terminals or phone jack

e. The Network Discharge Air Sensors shall include the following:

1. 4 inch or 8 inch duct insertion probe
2. 10 foot pigtail lead
3. Dip Switches for programmable address selection
4. Ability to provide an averaging temperature from multiple locations
5. Ability to provide a selectable temperature from multiple locations

f. The Network CO2 Zone Sensors shall include the following:

1. Available in either surface mount or wall mount
2. Available with screw terminals or phone jack

H. System Tools

1. System Configuration Tool

a. The Configuration Tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool for a Network Automation Engine (NAE) or a Network Integration Engine (NIE).

b. The configuration tool shall provide an archive database for the configuration and application data.

c. The configuration tool shall have the same look-and-feel at the User Interface (UI) regardless of whether the configuration is being done online or offline.

d. The configuration tool shall include the following features:

1. Basic system navigation tree for connected networks
2. Integration of Metasys N1, LonWorks, and BACnet enabled devices
3. Customized user navigation trees
4. Point naming operating parameter setting
5. Graphic diagram configuration
6. Alarm and event message routing
7. Graphical logic connector tool for custom programming
8. Downloading, uploading, and archiving databases

e. The configuration tool shall have the capability to automatically discover field devices on connected buses and networks. Automatic discovery shall be available for the following field devices:

1. BACnet Devices
2. LonWorks devices
3. N2 Bus devices
4. Metasys N1 networks

f. The configuration tool shall be capable of programming the Field Equipment Controllers.

1. The configuration tool shall provide the capability to configure, simulate, and commission the Field Equipment Controllers.
2. The configuration tool shall allow the FECs to be run in Simulation Mode to verify the applications.
3. The configuration tool shall contain a library of standard applications to be used for configuration.

g. The configuration tool shall be capable of programming the field devices.

1. The configuration tool shall provide the capability to configure, simulate, and commission the field devices.
2. The configuration tool shall allow the field devices to be run in Simulation Mode to verify the applications.
3. The configuration tool shall contain a library of standard applications to be used for configuration

h. A wireless access point shall allow a wireless enabled portable PC to make a temporary Ethernet connection to the automation network.
   1. The wireless connection shall allow the PC to access configuration tool through the web browser using the User Interface (UI).
   2. The wireless use of configuration tool shall be the same as a wired connection in every respect.
   3. The wireless connection shall use the Bluetooth Wireless Technology.

I. Input Devices

1. General Requirements
   a. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.
2. Temperature Sensors
   a. General Requirements:
      1. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
      2. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
      3. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	**Accuracy**
Chilled Water	± .5°F.
Room Temp	± .5°F.
Duct Temperature	± .5°F.
All Others	± .75°F.

   b. Room Temperature Sensors
      1. Room sensors shall be constructed for either surface or wall box mounting.
      2. Room sensors shall have the following options when specified:

```
Setpoint reset slide switch providing a ±3 degree
     (adjustable) range.
Individual heating/cooling setpoint slide switches.
A momentary override request push button for activation
     of after-hours operation.
Analog thermometer.
```

   c. Room Temperature Sensors with Integral Display
      1. Room sensors shall be constructed for either surface or wall box mounting.
      2. Room sensors shall have an integral LCD display and four button keypad with the following capabilities:

```
Display room and outside air temperatures.
Display and adjust room comfort setpoint.
Display and adjust fan operation status.
Timed override request push button with LED status for
     activation of after-hours operation.
Display controller mode.
```

Password selectable adjustment of setpoint and override modes.

d. Thermo wells
   1. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
   2. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
   3. Thermo wells and sensors shall be mounted in a threadolet or 1/2" NFT saddle and allow easy access to the sensor for repair or replacement.
   4. Thermo wells shall be constructed of 316 stainless steel.

e. Outside Air Sensors
   1. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
   2. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
   3. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

f. Duct Mount Sensors
   1. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
   2. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
   3. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

g. Averaging Sensors
   1. For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
   2. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
   3. Capillary supports at the sides of the duct shall be provided to support the sensing string.

h. Acceptable Manufacturers: Johnson Controls, Setra

3. Humidity Sensors
   a. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
   b. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
   c. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.

d. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.

e. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.

f. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.

g. Acceptable Manufacturers: Johnson Controls, Veris Industries, and Mamac.

4. Differential Pressure Transmitters

a. General Air and Water Pressure Transmitter Requirements:

1. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
2. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
3. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
4. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.

b. Low Differential Water Pressure Applications (0” - 20” w.c.)

1. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
2. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
```
.01-20” w.c. input differential pressure range.
4-20 mA output.
Maintain accuracy up to 20 to 1 ratio turndown.
Reference Accuracy: +0.2% of full span.
```
3. Acceptable Manufacturers: Setra and Mamac.

c. Medium to High Differential Water Pressure Applications (Over 21” w.c.)

1. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:
```
Differential pressure range 10” w.c. to 300 PSI.
Reference Accuracy: ±1% of full span (includes non-
     linearity, hysteresis, and repeatability).
```
2. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
3. Acceptable Manufacturers: Setra and Mamac.

d. Building Differential Air Pressure Applications (-1” to +1” w.c.)

1. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
2. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
   -1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)
   4-20 mA output.
   Maintain accuracy up to 20 to 1 ratio turndown.
   Reference Accuracy: +0.2% of full span.
3. Acceptable Manufacturers: Johnson Controls and Setra.

e. Low Differential Air Pressure Applications (0" to 5" w.c.)

1. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
2. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
   (0.00 - 1.00" to 5.00") w.c. input differential pressure ranges. (Select range appropriate for system application.)
   4-20 mA output.
   Maintain accuracy up to 20 to 1 ratio turndown.
   Reference Accuracy: +0.2% of full span.
3. Acceptable Manufacturers: Johnson Controls and Setra.

f. Medium Differential Air Pressure Applications (5" to 21" w.c.)

1. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:
   Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.
   Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.
   Thermal Effects: <+.033 F.S./Deg. F. over 40°F. to 100°F. (calibrated at 70°F.).
2. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
3. Acceptable manufacturers: Johnson Controls and Setra.

5. Flow Monitoring

a. Air Flow Monitoring

1. Fan Inlet Air Flow Measuring Stations
   At the inlet of each fan and near the exit of the inlet sound trap, airflow sensors shall be provided that shall continuously monitor the fan air volumes and system velocity pressure.

Each sensor shall be surface mount type. Unit shall be capable of monitoring and reporting the airflow and temperature at each fan inlet location through two or four sensing circuits. If a static pressure manifold is used, it shall incorporate dual offset static tops on the opposing sides of the averaging manifold so as to be insensitive to flow-angle variations of as much as ± 20° in the approaching air stream.

Devices creating fan performance degradation, resulting in additional energy consumption, caused from pressure drop associated with probes or mounting apparatus in the center of the fan inlet are not allowed. The device shall not induce a measurable pressure drop, nor shall the sound level within the duct be amplified by its singular or multiple presence in the air stream. Sensor circuit casings shall be constructed of U.L. 94 flame rated, high impact ABS and include a stainless steel thermistor cap that maintains the precise calibrated flow over the heated and ambient measurement points. Each sensor circuit shall consist of two ceramic base, glass encapsulated, thermistors for measuring ambient temperature and velocity. Circuit shall be designed for operation in a wide range of environments, including high humidity and rapid thermal cycling.

Acceptable manufacturers are: Johnson Controls, Air Monitor Corp., Tek-Air Systems, Inc., or Dietrich Standard.

2. Single Probe Air Flow Measuring Sensor

The single probe airflow-measuring sensor shall be duct mounted with an adjustable sensor insertion length of up to eight inches. The transmitter shall produce a 4-20 mA or 0-10 VDC signal linear to air velocity. The sensor shall be a hot wire anemometer and utilize two temperature sensors and a heater element temperature. The other sensor shall measure the downstream air temperature. The temperature differential shall be directly related to airflow velocity.

3. Duct Air Flow Measuring Stations

Furnish and install, at locations shown on plans or as in accordance with schedules, an equalized air measuring probe system piped to a high performance pressure transducer or an electronic type airflow temperature measuring station.

Each device shall be designed and built to comply with, and provide results in accordance with, accepted practice as defined for system testing in the ASHRAE Handbook of fundamentals, as well as in the Industrial Ventilation Handbook.

Assembly shall be AMCA tested and capable of measuring a range from 70 to 5,000 FPM (22 to 1524 MPM).

Equalized air measuring assembly shall measure to ±3% average and consist of 6063T5 extruded aluminum

step sensing blade(s) with anodized finish, plenum-rated polyethylene pressure tubing, brass barbed fittings, mounting hardware and a glass-on-silicone capacitance sensor pressure transducer capable of measuring up to six field-selectable pressure ranges up to 1 in. w.c.

The transducer shall be accurate to ±1% of full scale and be contained in a National Electrical Manufacturer's Association (NEMA) 4 (IP-65) enclosure. Transducer shall be factory mounted and piped to high and low pressure ports through fittings made of brass.

All sensor tubing shall terminate in solid brass barbed fittings.

Total and static pressure manifolds shall terminate with external ports for connection to control tubing. An identification label shall be placed on each unit casing, listing model number, size, area, and specified airflow capacity.

Air straightener shall be provided for sizes over 17 square feet (1.6 sq meter).

Airflow measuring station assemblies shall be fabricated of galvanized steel or aluminum casing of appropriate thickness for slip fits or with 90 Deg. connecting flanges in configuration and size equal to that of the duct into which it is mounted. Each station shall be complete with an air directionalizer and parallel cell profile suppressor (3/4″ maximum cell) across the entering air stream and mechanically fastened to the casing in such a way to withstand velocities up to 6000 feet per minute. This air directionalizer and parallel cell honeycomb suppressor shall provide 98% free area, equalize the velocity profile, and eliminate turbulent and rotational flow from the air stream prior to the measuring point.

Equalized air measuring probe assemblies shall be, in all respects, equivalent to Johnson Controls® AD-1250 or AD-1251 airflow measuring systems.

Electronic air measuring station shall be capable of monitoring and reporting the airflow and temperature at each measuring location through one or more measuring probes containing multiple sensor points and a control transmitter that communicates with the BAS.

Probe(s) shall be constructed of an airfoil shaped aluminum extrusion containing the sensor circuit(s).

Each sensor circuit shall consist of coated thermistors, for temperature and velocity, mounted to a Printed Circuit Board (PCB).

Probe multiplexer circuit(s) shall include a microprocessor that collects data from each PCB and digitally communicates the average airflow and temperature of each probe to a microprocessor based control transmitter.

Multiplexer board shall be encased to prevent moisture damage.
Shielded CAT5e communications cable shall be Underwriters Laboratories Inc.® (UL) plenum-rated with RJ45 terminal connectors. Dust boot covers and gold-plated contacts shall link probes to electronic controller.
Control transmitter shall be capable of processing independent sensing points and shall operate on a fused 24 VAC supply.
Control transmitter shall feature a 16 x 2 character alphanumeric LCD screen, digital offset/gain adjustment, continuous performing sensor/transmitter diagnostics, and a visual alarm to detect malfunctions.
All electronic components of the assembly shall be Restriction of Hazardous Substances (RoHS) Directive compliant.
Installation Considerations

(i) The maximum allowable pressure loss through the Flow and Static Pressure elements shall not exceed .065" w.c. at 1000 feet per minute, or .23" w.c. at 2000 feet per minute. Each unit shall measure the airflow rate within an accuracy of plus 2% as determined by U.S. – GSA certification tests, and shall contain a minimum of one total pressure sensor per 36 square inches of unit measuring area.

(ii) Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.

(iii) Where control dampers are shown as part of the airflow measuring station, parallel blade precision controlled volume dampers integral to the station and complete with actuator, and linkage shall be provided.

(iv) Stations shall be installed in strict accordance with the manufacturer's published requirements, and in accordance with ASME Guidelines affecting non-standard approach conditions.

All air measuring devices shall be tested according to AMCA Standard 610
Acceptable manufacturers: Johnson Controls, Air Monitor Corp., Tek-Air, and Dietrich Standard.

4. Static Pressure Traverse Probe

Duct static traverse probes shall be provided where required to monitor duct static pressure. The probe shall contain multiple static pressure sensors located along exterior surface of the cylindrical probe.
Acceptable manufacturers: Cleveland Controls

5. Shielded Static Air Probe

A shielded static pressure probe shall be provided at each end of the building. The probe shall have multiple sensing ports, an impulse suppression chamber, and airflow shielding. A suitable probe for indoor and outdoor locations shall be provided.

b. Water Flow Monitoring

Water flow meters shall be electromagnetic type with integral microprocessor-Based electronics. The meter shall have an accuracy of 0.25%.
Acceptable manufacturers: Onicon

6. Power Monitoring Devices

a. Current Measurement (Amps)

1. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.
2. Current Transformer – A split core current transformer shall be provided to monitor motor amps.
Operating frequency – 50 - 400 Hz.
Insulation – 0.6 Kv class 10Kv BIL.
UL recognized.
Five amp secondary.
Select current ration as appropriate for application.
Acceptable manufacturers: Veris Industries
3. Current Transducer – A current to voltage or current to mA transducer shall be provided. The current transducer shall include:
6X input over amp rating for AC inrushes of up to 120 amps.
Manufactured to UL 1244.
Accuracy: +.5%, Ripple +1%.
Minimum load resistance 30kOhm.
Input 0-20 Amps.
Output 4-20 mA.
Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).
Acceptable manufacturers: Veris Industries

7. Refrigerant Leak Detectors

a. The refrigerant leak detector shall be a standalone device and shall provide a SPDT output to directly energize the refrigeration room exhaust ventilation fans. The detector shall include a sensor or sensors connected to a control panel. Two relay contacts at the control panel shall provide trouble and alarm indication to the Facility Management System. The alarm relay contact shall also directly energize the exhaust fans.

b. The refrigerant leak detector shall sense the type of refrigerant used in the specified chillers. Multiple sensors shall be required to detect different refrigerants and/or provide proper sensing coverage for the area of the refrigeration room.

c. Acceptable manufacturers: Johnson Controls, MSA Instruments

8. Smoke Detectors
    a. Ionization type air duct detectors shall be furnished as specified elsewhere in Division 16 for installation under Division 15. All wiring for air duct detectors shall be provided under Division 16, Fire Alarm System.
9. Status and Safety Switches
    a. General Requirements
        1. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.
    b. Current Sensing Switches
        1. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
        2. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
        3. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
        4. Acceptable manufacturers: Veris Industries
    c. Air Filter Status Switches
        1. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
        2. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
        3. Provide appropriate scale range and differential adjustment for intended service.
        4. Acceptable manufacturers: Johnson Controls, Cleveland Controls
    d. Air Flow Switches
        1. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
        2. Acceptable manufacturers: Johnson Controls, Cleveland Controls
    e. Air Pressure Safety Switches
        1. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
        2. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
        3. Acceptable manufacturers: Johnson Controls, Cleveland Controls
    f. Water Flow Switches
        1. Water flow switches shall be equal to the Johnson Controls P74.

g. Low Temperature Limit Switches

1. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
2. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
3. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
4. The low temperature limit switch shall be equal to Johnson Controls A70.

J. Output Devices

1. Actuators

a. General Requirements

1. Damper and valve actuators shall be electronic and/or pneumatic, as specified in the System Description section.

b. Electronic Damper Actuators

1. Electronic damper actuators shall be direct shaft mount.
2. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized Based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.
3. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
4. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.
5. Acceptable manufacturers: Johnson Controls, Mamac.

c. Electronic Valve Actuators

1. Electronic valve actuators shall be manufactured by the valve manufacturer.
2. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.
3. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized Based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.
4. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
5. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.
6. Acceptable manufacturers: Johnson Controls

2. Control Dampers
   a. The BMS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BMS Contractor or as specifically indicated on the Drawings.
   b. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.
   c. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.
   d. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.0 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.

e. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5" w.g., but no more than 4000 FPM or 6" w.g. Acceptable manufacturers are Johnson Controls VD-1250, VD1630, or VD-1330, Ruskin CD50 or CD60, and Vent Products 5650.

f. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below. Acceptable manufacturers are: Johnson Controls VD-1620, VD-1320, Ruskin CD36, and Vent Products 5800.

g. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

3. Control Relays

a. Control Pilot Relays

1. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
2. Mounting Bases shall be snap-mount.
3. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
4. Contacts shall be rated for 10 amps at 120VAC.
5. Relays shall have an integral indicator light and check button.
6. Acceptable manufacturers: Johnson Controls, Lectro

b. Lighting Control Relays

1. Lighting control relays shall be latching with integral status contacts.
2. Contacts shall be rated for 20 amps at 277 VAC.
3. The coil shall be a split low-voltage coil that moves the line voltage contact armature to the ON or OFF latched position.
4. Lighting control relays shall be controlled by:
   Pulsed Tri-state Output – Preferred method.
   Pulsed Paired Binary Outputs.
   A Binary Input to the Facility Management System shall monitor integral status contacts on the lighting control relay. Relay status contacts shall be of the "dry-contact" type.
5. The relay shall be designed so that power outages do not result in a change-of-state, and so that multiple same state commands will simply maintain the commanded state. Example: Multiple OFF command pulses shall simply keep the contacts in the OFF position.

4. Control Valves

a. All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Specification.

b. Chilled water control valves shall be modulating plug, ball, and/or butterfly, as required by the specific application. Modulating water valves shall be sized per manufacturer's recommendations for the given application. In general, valves (2 or 3-way) serving **variable** flow air handling unit coils shall be sized for a pressure drop equal to the actual coil pressure drop, but no less than 5 PSI. Valves (3-way) serving **constant** flow air handling unit coils with secondary circuit pumps shall be sized for a pressure drop equal to 25% the actual coil pressure drop, but no less than 2 PSI. Mixing valves (3-way) serving secondary water circuits shall be sized for a pressure drop of no less than 5 PSI. Valves for terminal reheat coils shall be sized for a 2 PSIG pressure drop, but no more than a 5 PSI drop.

c. Ball valves shall be used for hot and chilled water applications, water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units except those described hereinafter.

d. Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all special applications as indicated on the valve schedule. Valve discs shall be composition type. Valve stems shall be stainless steel.

e. Butterfly valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or three-way butterfly valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. Valves for modulating service shall be sized and travel limited to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.

f. Acceptable manufacturers: Johnson Controls

5. Electronic Signal Isolation Transducers

a. A signal isolation transducer shall be provided whenever an analog output signal from the BMS is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input signal from a remote system.

b. The signal isolation transducer shall provide ground plane isolation between systems.

c. Signals shall provide optical isolation between systems.

d. Acceptable manufacturers: Advanced Control Technologies

6. External Manual Override Stations

a. External manual override stations shall provide the following:

1. An integral HAND/OFF/AUTO switch shall override the controlled device pilot relay.
2. A status input to the Facility Management System shall indicate whenever the switch is not in the automatic position.
3. A Status LED shall illuminate whenever the output is ON.
4. An Override LED shall illuminate whenever the HOA switch is in either the HAND or OFF position.
5. Contacts shall be rated for a minimum of 1 amp at 24 VAC.

7. Electronic/Pneumatic Transducers

a. Electronic to Pneumatic transducers shall provide:

1. Output: 3-15 PSIG.
2. Input: 4-20 mA or 0-10 VDC.
3. Manual output adjustment.
4. Pressure gauge.
5. External replaceable supply air filter.
6. Acceptable manufacturers: Johnson Controls, Mamac

K. Miscellaneous Devices

1. Variable Frequency Motor Speed Control Drives

A. Where shown on the drawings, adjustable frequency drives 1 through 150 HP shall have the following features:

1. The VSDs shall be rated for 480 Vac (optional input voltages of 208 Vac through 60 HP, 240 Vac through 75 HP). The VSD shall provide microprocessor based control for three-phase induction motors. The controller's full load output current rating shall be based on variable torque application at 40° C ambient and 1-16 kHz switching frequency below 50 HP and 1-10 kHz 50 HP and above to reduce motor noise and avoid increased motor losses.

2. The VSDs shall be of the Pulse Width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output via a two-step operation. Adjustable Current Source VSDs are not accepted. Insulated Gate Bipolar Transistors (IGBTs) shall be used in the inverter section. Bipolar Junction Transistors, GTOs or SCRs are not accepted. The VSD shall run at the above listed switching frequencies.

3. The VSDs shall have efficiency at full load and speed that exceeds 95% for VSDs below 15 HP and 97% for drives 15 HP and above. The efficiency shall exceed 90% at 50% speed and load.

4. The VSDs shall maintain a minimum line side displacement power factor of 0.96, regardless of speed and load.

5. The VSDs shall have a one (1) minute overload current rating of 110% for variable torque applications.

6. The VSDs shall be capable of operating any NEMA design B squirrel cage induction motor, regardless of manufacturer, with a horsepower and current rating within the capacity of the VSD.

7. The VSDs shall have an integral EMI/RFI filter as standard.

8. The VSDs shall limit harmonic distortion reflected onto the utility system to voltage and current levels as defined by IEEE 519-1992 for general systems applications, by utilizing the standard 3% nominal impedance integral ac three-phase line reactor. DC link chokes are not accepted.

9. Any harmonic calculations shall be done based on the kVA capacity, X/R ratio and the impedance of the utility transformer feeding the installation, as noted on the drawings, and the total system load. The calculations shall be made with the point of common coupling (PCC) being the point where the utility feeds multiple customers.

10. Total harmonic distortion shall be calculated under worst case conditions in accordance with the procedure outlined in IEEE 519-1992. Copies of these calculations are to be made available upon request. The contractor shall provide any needed information to the VSD supplier three (3) weeks prior to requiring harmonic calculations.

11. The system containing the VSDs shall comply with the 5% level of total harmonic distortion of line voltage and the line current limits as defined in IEEE 519-1992. If the system cannot meet the harmonic levels with the VSDs provided with the standard input line reactor or optional input isolation transformer, the VSD manufacturer shall supply an eighteen pulse, multiple bridge rectifier ac to dc conversion section with phase shifting transformer for all drives above 75 HP. This eighteen pulse rectifier converter shall result in a multiple pulse current waveform that will more nearly approximate a true sinewave to reduce voltage harmonic content on the utility line. The phase shifting transformer shall be of a single winding type to optimize its KVA rating and harmonic cancellation capability.

    Harmonic filters are not accepted above 75 HP.

12. The VSDs shall be able to start into a spinning motor. The VSDs shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VSDs shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.

    Standard operating conditions shall be:[1]

    A. Incoming Power: Three-phase, 208 / 240 / 480 (+10% to -15%) and 50/60 Hz (+/-5 Hz) power to a fixed potential DC bus level.

    B. Frequency stability of +/-0.05% for 24 hours with voltage regulation of +/-1% of maximum rated output voltage.

    C. Speed regulation of +/- 0.5% of base speed.

    D. Load inertia dependant carryover (ridethrough) during utility loss.

    E. Insensitive to input line rotation.

    F. Humidity: 0 to 95% (non-condensing and non-corrosive).

    G. Altitude: 0 to 3,300 feet (1000 meters) above sea level.

[1] Consultant to choose correct system voltage

H. Ambient Temperature: -10 to 40 °C (VT).

I. Storage Temperature: -40 to 70 °C.

13. Control Functions

A. Frequently accessed VSD programmable parameters shall be adjustable from a digital operator keypad located on the front of the VSD. The VSDs shall have a 3 line alphanumeric programmable display with status indicators. Keypads must use plain English words for parameters, status, and diagnostic messages. Keypads that are difficult to read or understand are not accepted, and particularly those that use alphanumeric code and tables. Keypads shall be adjustable for contrast with large characters easily visible in normal ambient light.

B. The keypad shall include a Hand-Off-Auto membrane selection and an Inverter/Bypass membrane selection. When in "Hand" the VSD will be started and the speed will be controlled from the up/down arrows. When in "Off", the VSD will be stopped. In "Auto", the VSD will start via an external contact closure or a communication network and the VSD speed will be controlled via an external speed reference.

C. The keypad shall have copy / paste capability.

D. Upon initial power up of the VSD, the keypad shall display a start up guide that will sequence all the necessary parameter adjustments for general start up.

E. Standard advanced programming and trouble-shooting functions shall be available by using a personal computer's RS-232 port and Windows™ based software. In addition the software shall permit control and monitoring via the VSD's RS232 port. The manufacturer shall supply a diskette with the required software. An easily understood instruction manual and software help screens shall also be provided. The computer software shall be used for modifying the drive setup and reviewing diagnostic and trend information as outlined in this section through section 18.

F. The operator shall be able to scroll through the keypad menu to choose between the following:

1. Parameter Menu
2. Keypad Control
3. System Menu
4. Expander Boards
5. Monitoring Menu
6. Operate Menu

G. The following setups and adjustments, at a minimum, are to be available:

1. Start command from keypad, remote or communications port
2. Speed command from keypad, remote or communications port
3. Motor direction selection
4. Maximum and minimum speed limits
5. Acceleration and deceleration times, two settable ranges
6. Critical (skip) frequency avoidance
7. Torque limit
8. Multiple attempt restart function
9. Multiple preset speeds adjustment
10. Catch a spinning motor start or normal start selection
11. Programmable analog output

14. The VSD shall have the following system interfaces:

A. Inputs – A minimum of six (6) programmable digital inputs, two (2) analog inputs and serial communications interface shall be provided with the following available as a minimum:

1. Remote manual/auto
2. Remote start/stop
3. Remote forward/reverse
4. Remote preset speeds
5. Remote external trip
6. Remote fault reset
7. Process control speed reference interface, 4-20mAdc
8. Potentiometer or process control speed reference interface, 0 - 10Vdc
9. RS232 programming and operation interface port

B. Outputs – A minimum of two (2) discrete programmable digital outputs, one (1) programmable open collector output, and one (1) programmable analog output shall be provided, with the following available at minimum.

1. Programmable relay outputs with one (1) set of Form C contacts for each, selectable with the following available at minimum:

a. Fault
b. Run
c. Ready
d. Reversing
e. Jogging
f. At speed
g. In torque limit
h. Motor rotation direction opposite of commanded
i. Overtemperature

2. Programmable open collector output with available 24Vdc power supply and selectable with the following available at minimum:

    a. Fault
    b. Run
    c. Ready
    d. Reversing
    e. Jogging
    f. At speed
    g. In torque limit
    h. Motor rotation direction opposite of commanded
    i. Overtemperature

3. Programmable analog output signal, selectable with the following available at minimum:

    a. Output frequency
    b. Frequency reference
    c. Motor speed
    d. Output current
    e. Motor torque
    f. Motor power
    g. Motor voltage
    h. DC link voltage
    i. PID controller reference value
    j. PID controller actual value 1
    k. PID controller actual value 2
    l. PID controller error value
    m. PID controller output

C. Capability of two additional expandable I/O interface cards. Upon installation, software shall automatically identify the interface card and activate the appropriate parameters.

15. Monitoring and Displays

A. The VSD's display shall be a LCD type capable of displaying three (3) lines of text and the following thirteen (13) status indicators:

    1. Run
    2. Forward
    3. Reverse
    4. Stop
    5. Ready
    6. Alarm
    7. Fault
    8. I/O Terminal
    9. Keypad
    10. Bus/comm

11. Hand
12. Auto
13. Off

B. The VSD's keypad shall be capable of displaying the following monitoring functions at a minimum:

1. Motor Speed (RPM and %)
2. Frequency reference
3. Output frequency
4. Motor current
5. Motor torque
6. Motor power
7. Motor voltage
8. DC-link voltage
9. Heatsink temperature
10. Motor run time (resetable)
11. Total operating days counter
12. Operating hours (resetable)
13. Total megawatt hours
14. Megawatt hours (resetable)
15. Voltage level of analog input
16. Current level of analog input
17. Digital inputs status
18. Digital and relay outputs status
19. Motor temperature rise
20. PID references

16. Protective Functions

A. The VSD shall include the following protective features at minimum:

1. Overcurrent
2. Overvoltage
3. System fault
4. Undervoltage
5. Input line supervision
6. Output phase supervision
7. Undertemperature
8. Overtemperature
9. Motor stalled
10. Motor overtemperature
11. Motor underload
12. Logic voltage failure
13. Microprocessor failure
14. Brake chopper supervision
15. DC Injection braking

B. The VSD shall provide ground fault protection during power-up, starting, and running. VSD's with no ground fault protection during running are not accepted.

17. Diagnostic Features

A. Active Faults
1. The last 10 faults shall be recorded and stored in sequential order
2. Fault code and description of fault shall be displayed on the keypad.
3. Fault or alarm LED shall blink
4. Display drive data at time of fault
5. In the event several faults occur simultaneously, the sequence of active faults shall be viewable.

B. Fault History
1. The last 30 faults shall be recorded and stored in sequential order.
2. Display drive data at time of fault

18. Additional features included in the VSDs:[2]

A. A HMCP or MMP device shall provide a disconnect means with provision for lockout. Disconnect handles mounted on the door will not be accepted. The handle position shall indicate ON and OFF condition. Operator shall be interlocked with cover to prevent opening with disconnect in the ON position.

B. A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor that is electrically and mechanically interlocked. Both contactors must to be fully rated at the current of the drive and motor.

C. Optional third contactor to allow the VSD to completely disconnect all three phases from the line for maximum drive isolation. Fused drive isolation must also be available as an option.

D. The following indicating lights shall be provided on the keypad. .
1. Drive/Bypass Ready (Flashing in Bypass Mode)
2. Drive/Bypass Run
3. Drive Fault

E. The current withstand rating of the drive shall be 100,000 AIC. The bypass shall have an interrupting capacity of 65,000 AIC or greater. The combined withstand rating of drive and bypass must be 65,000 AIC or higher.

F. Communication card for interface with existing BAS control system

G. The VSD shall have a cooling fan that is field replaceable using non-screw accessibility.

19. Enclosure[3]

    A. Two- or three-contactor design utilizing low voltage coils.

    B. Drive and bypass fully integrated. Bypass configured between the control and power sections of the VSD.

    C. HOA and bypass integrated into the keypad design.

    D. The VSD and bypass shall be designed in a NEMA Type 1 enclosure to provide enhanced protection against radiated EMI/RFI.

    E. The VSD shall have complete front accessibility with easily removable assemblies.

    F. Cable entry shall be top or bottom entry.

20. The VSD manufacturer shall maintain, as part of a national network, engineering service facilities within 250 miles of project to provide start-up service, emergency service calls, repair work, service contracts, maintenance and training of customer personnel.

2. Local Control Panels
    a. All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
    b. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
    c. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
    d. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
    e. All wiring shall be neatly installed in plastic trays or tie-wrapped.
    f. A 120 volt convenience outlet, fused on/off power switch, and required transformers shall be provided in each enclosure.
3. Power Supplies
    a. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
    b. Input: 120 VAC +10%, 60Hz.

c. Output: 24 VDC.

d. Line Regulation: +0.05% for 10% line change.

e. Load Regulation: +0.05% for 50% load change.

f. Ripple and Noise: 1 mV rms, 5 mV peak to peak.

g. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.

h. A power disconnect switch shall be provided next to the power supply.

4. Thermostats

a. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

3.26 Part 3 – Performance / Execution

A. BMS Specific Requirements

1. Graphic Displays

a. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.

b. User shall access the various system schematics via a graphical penetration scheme and/or menu selection. .

2. Custom Reports:

1. Provide custom reports as required for this project.

Actuation / Control Type

a. Primary Equipment

1. Controls shall be provided by equipment manufacturer as specified herein.

2. All damper and valve actuation shall be electric.

b. Air Handling Equipment

1. All air handers shall be controlled with a HVAC-DDC Controller, provided by equipment manufacturer and compatible with existing BAS system.

2. All damper and valve actuation shall be electric.

c. Terminal Equipment:

1. Terminal Units (VAV, UV, etc.) shall have electric damper and valve actuation.

2. All Terminal Units shall be controlled with HVAC-DDC Controller, provided by equipment manufacturer and compatible with existing BAS system.

3. Installation Practices

a. BMS Wiring

1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply

with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.

2. All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations.
3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
4. Class 2 Wiring
5. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
6. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
7. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
8. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

b. BMS Line Voltage Power Source

1. 120-volt AC circuits used for the Building Management System shall be taken from panel boards and circuit breakers provided by Division 16.
2. Circuits used for the BMS shall be dedicated to the BMS and shall not be used for any other purposes.
3. DDC terminal unit controllers may use AC power from motor power circuits.

c. BMS Raceway

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".
2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

4. Penetrations

a. Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.

b. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.

c. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.

d. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

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5. BMS Identification Standards

a. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.

Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

6. BMS Panel Installation

a. The BMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.

b. The BMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

7. Input Devices

a. All Input devices shall be installed per the manufacturer recommendation

b. Locate components of the BMS in accessible local control panels wherever possible.

8. HVAC Input Devices – Genera1

a. All Input devices shall be installed per the manufacturer recommendation

b. Locate components of the BMS in accessible local control panels wherever possible.

c. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.

d. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.

e. Outside Air Sensors

1. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.

2. Sensors shall be installed with a rain proof, perforated cover.

f. Water Differential Pressure Sensors

1. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.

2. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.

3. The transmitters shall be installed in an accessible location wherever possible.

g. Medium to High Differential Water Pressure Applications (Over 21" w.c.):

1. Air bleed units, bypass valves and compression fittings shall be provided.

h. Building Differential Air Pressure Applications (-1" to +1" w.c.):

1. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
2. The interior tip shall be inconspicuous and located as shown on the drawings.

i. Air Flow Measuring Stations:

1. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct.
2. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.

j. Duct Temperature Sensors:

1. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
2. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
3. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
4. The sensor shall be mounted to suitable supports using factory approved element holders.

k. Space Sensors:

1. Shall be mounted per ADA requirements.
2. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.

l. Low Temperature Limit Switches:

1. Install on the discharge side of the first water or steam coil in the air stream.
2. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
3. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.

m. Air Differential Pressure Status Switches:

1. Install with static pressure tips, tubing, fittings, and air filter.

n. Water Differential Pressure Status Switches:

1. Install with shut off valves for isolation.

9. HVAC Output Devices

a. All output devices shall be installed per the manufacturers recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.

b. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.

c. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.

d. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.

e. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

B. Training

1. The BMS contractor shall provide the following training services:

a. One day of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

C. Commissioning

1. Fully commission all aspects of the Building Management System work.
2. Acceptance Check Sheet

a. Prepare a check sheet that includes all points for all functions of the BMS as indicated on the point list included in this specification.

b. Submit the check sheet to the Engineer for approval

c. The Engineer will use the check sheet as the basis for acceptance with the BMS Contractor.

3. VAV box performance verification and documentation:

a. The BMS Contractor shall test each VAV box for operation and correct flow. At each step, after a settling time, box air flows and damper positions will be sampled. Following the tests, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.

b. The BMS Contractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance.

4. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

D. Sequences

1. Packaged Rooftop Units

a. General:

1. Equipment with Simplicity as standard shall be factory mounted and run tested through the control, after the test is complete; there will be no wires to re-connect. All control wiring points shall be tested and verified through communication.
2. The control shall be UL or CSA recognized. The control shall be manufactured in a manufacturing facility that is certified to ISO 9001.
3. The factory mounted controls shall be capable of communication via BACnet protocol and must fully integrate with the existing Johnson Controls Metasys Extended Architecture.

A. COMPRESSOR CONTROL
1. The control shall have a five-minute Anti-Short Cycle Delay to prevent excessive compressor cycling.
2. The control shall have a three-minute minimum run time to insure that oil is returned to the compressor each time it starts. The minimum runtime shall be programmable up to 10 minutes.
3. The control shall monitor the High Pressure switch, the Low Pressure switch, and the Compressor Overloads separately for each refrigeration circuit.
4. The control shall have a 30 second Low Pressure Switch bypass when it starts any compressor.
5. A hard compressor lockout shall occur if the control detects the same switch trip three times in a two-hour window, which starts when the first trip occurs. On the first and second trips, the control will turn the compressor off and wait five-minutes after the switch re-closes, before restarting the compressor.
6. The control shall be capable of operating both compressors and the economizer when there is a call for both stages of cooling.
7. The control shall have a means of locking out mechanical compression below a programmable low ambient trip point. This must be done without adding extra components to the unit.
8. The control shall have a means of locking out the mechanical compression when the economizer is operating in free cooling mode without additional components
9. The control shall have a means of starting the compressor before the indoor Fan comes on when operating with a Thermostat in the AUTO FAN mode.

B. FAN CONTROL
1. The control shall have fully adjustable Fan ON and Fan OFF delays for both Heating and Cooling settable at the control or via communication.
2. The control's default Fan OFF delay for Cooling shall be 30 seconds to take advantage of the remaining capacity in the coil after the compressor has been turned off.
3. The control shall lock on the Fan if the high temperature limit trips three times in one hour of operation.
4. The control will have a software programmable Fan Mode Switch for Auto operation or Continuous operation.
5. When the Fan is in the Continuous mode, it will run continuously during the occupied schedule and in the Auto mode when in an unoccupied schedule.
6. The control shall be capable of operating the fan without a G or fan signal from the thermostat.

C. EQUIPMENT CONTROL FEATURES

1. The control shall be capable of communicating on the Standard Open protocol, MODBUS RTU.
2. The register data for the MODBUS must be publicly available and open.
3. Monitoring software shall be provided at no cost. The monitoring software shall have a flashing icon when any unit wired to the computer has an alarm. Clicking the flashing icon shall display the fault code and the details of the fault.
4. The networking setup shall be completed by connecting a three-wire daisy chain cable to each unit, then powering all the units up and pushing a button on each control. There shall not be any dipswitches to configure the network address.
5. The control shall use a communication driver that is capable of having 64 nodes on the bus before a repeater is needed.
6. The control shall use non-volatile memory to store the last five alarms. There shall be a single button to push to
7. recall these last five alarms. The alarms shall be stored first in last out. The first flash code shall be the last alarm
8. that occurred. There shall be a button press sequence to clear the alarms in non-volatile memory.
9. 7. The control shall have a button to reset compressor lockouts without powering the unit down.
10. The control shall have a button to clear compressor Anti- Short Cycle Delays (ASCDs). When this button is pressed it will only clear the ASCDs for one cycle only and not permanently.
11. The control will be compatible with any BAS (Building Automation System). Any BAS shall be able to control the equipment when wired to the control's Thermostat Terminal Strip.
12. The control shall have loading of at least 25 milliamps on all thermostat inputs for controllers and thermostats that use output TRIACs.
13. The control shall have a Smoke Detector Shutdown input on the board. The control shall be powered through this input, so when the Smoke Detector trips, the control will shut down the unit immediately.
14. The control will have low voltage protection for the contactors and will not energize a contactor if the voltage is below 19.2 VAC, to insure contactor pull-in. If the control has a compressor contactor energized when the voltage drops, it shall not de-energize the contactor until the voltage drops below 16 VAC, which is the drop out voltage for most contactors.
15. The control shall have a means of low ambient control without adding any additional components. The control shall have a means of cycling the compressor on for 10 minutes and off for 5 minutes to defrost the indoor coil when the outside ambient is below a low ambient switch point without adding additional components.
16. The control shall have a means of storing compressor run time. This data shall be available through communication. The control shall have the ability to clear this data when a compressor is replaced.
17. The control shall have the ability to store a name of at least 26 characters in length. The control will leave the factory with the serial number of the equipment it is in, stored in non-volatile memory in the Name location.
18. The control shall have the ability to store the model number of the equipment of at least 26 characters in length. The control will leave the factory with the model number of the equipment it is in, stored in non-volatile memory.
19. The control shall have the ability to store the serial number of the equipment of at least 26 characters in length. The control will leave the factory with the serial number of the equipment it is in, stored in non-volatile memory.

20. The control shall not power the contactors through the thermostat wiring. Dropping voltage over the thermostat wiring causes chattering contactors when the contactors are powered in this manner.
21. The control will operate and monitor up to 3 stages of heat independently.
22. The control shall monitor the Gas Heat operation in the heating mode. It shall monitor the gas valve when there is a call for heating. The control shall alarm when there is a call for heat and no gas valve voltage after 5 minutes.
23. There will only be one control board for this series of units, for both CV and VAV operation.

D. COMFORT CONTROL FEATURES
1. The control will be installed and tested at the factory where the equipment is assembled.
2. The control will use a Wall Sensor that has a means of overriding the unoccupied mode for a programmable amount of time.
3. The Unoccupied Override time will be programmed in minutes up to 4 hours.
4. The control will use a Wall Sensor that has a warmer/ cooler dial so the occupants can offset the programmed setpoint by a programmed amount between 1 and 5 degrees fahrenheit.
5. The control will have a Supply Air Sensor as standard.
6. The control will have a Return Air Sensor as standard.
7. The control will have an Outside Air Sensor as standard.
8. The control will use the Return Air Sensor in place of the
9. Space Sensor if the Space Sensor fails for any reason,
10. The control will have a 365 day Real Time Clock.
11. The Real Time Clock will be able to do automatic Daylight Savings Time adjustment.
12. The control will have an Occupancy Schedule that allows two different Occupied schedules per day for each of the seven days of the week individually.
13. The control will have 20 Holiday Schedules, each capable of 99 days.
14. The control's Holiday Schedules will have a start time associated with each schedule.
15. The control will control the Economizer directly.
16. The control will be capable of operating the Economizer using Dry Bulb, Outside Enthalpy, or Differential Enthalpy.
17. When the control is using Enthalpy to control the Economizer, it will also have an Outside Air Temperature enable Setpoint.
18. The control will use two setpoints for Supply Air Temperature for the Economizer operation. One will be for a small space cooling demand and one for a large space cooling demand.
19. The control will have the ability to perform Demand Ventilation using one CO2 sensor.
20. The control will have a programmable maximum Outside Air Damper Position for IAQ operation.
21. The control will have the ability to temper the ventilation air during times when heating or cooling is not required.
22. The control will have the ability to offset the operating setpoint based on high Humidity in the Space.
23. The control will have programmable limits when offsetting the Operating Setpoint to control Humidity.
24. The control must be able to lockout Cooling below a programmable Outside Air Temperature Setpoint.
25. The control will be able to lockout Heating above a programmable Outside Air Temperature Setpoint.
26. The control will have a Space Temperature Alarm.

27. The control will have a Supply Air Temperature Alarm for Heating and Cooling. The Alarm temperature will be programmable.
28. The Control will be able to perform a Pre-Occupancy Purge at a Programmable Time.
29. The control will have a hardware Smoke-Purge input.
30. The control will have the ability to read a dirty filter switch.
31. The control will have the capability of reading a fan proving switch.
32. The control will have an intelligent recovery function that will bring the space to the Occupied Setpoint just before or at the beginning of the first Occupied schedule each day. The control will learn and apply the minimum run time required to heat or cool the space to setpoint for the first Occupied period of a day.
33. The control will have Software controllable Mode Switches (Heat, Cool, and Fan).
34. The control will meter and track Unoccupied Override Time for billing purposes.

3.6 Point Lists

PIPE OR EQUIPMENT	TYPE OF ALARM, CONTACT POINT OR CONDITION WHICH SHALL BE MONITORED BY BAS	CONTROL	LOCATION
Main Alarm Check Valve	Open	Pressure Switch	Sprinkler Room – Basement Floor Level
Fire Protection Supply	Low Pressure	Pressure Switch	Sprinkler Room – Basement Floor Level

SERVICE OR EQUIP	PRESSURE	TEMP	FLOW	TROUBLE	CONTROL	LOCATION
Dental Vacuum Pumps Typical for (3) Pumps	X	X			Control Panel	Mech Rm Basement 002
Master Gas Alarm Panel				X	Alarm Panel	Corridor 230
Area Alarm Panel				X	Alarm Panel	Corridor 230
Air Compressor				X	Control Panel	Reciving Dock 138A
Dental Air Compressor Typical for (3) Compressors				X	Control Panel	Mech Rm Basement 002

Amalgam Seperation System				X	BAS	Mech Rm Basement 002

SERVICE OR EQUIP	PRESSURE	TEMP	FLOW	TROUBLE	CONTROL	LOCATION
Domestic Water Heaters		X			By BAS	Mech Rm Basement
Sewer Ejector Pumps				X	Contacts in Control Panel	Mech Rm Basement
Elevator Sump Pumps			X	X	Contacts in Control Panel	Elevator Machine Rooms
Water Service Entrance	X				By BAS	Mech Rm Basement
Building Hot Water		X			By BAS	Mech Rm Basement HW Mixing Valve
RO System				X	By BAS	2ed Floor

HVAC Points shall be as needed to integrate with the existing BAS system. 25 Electrical Points shall be as needed to integrate with the existing BAS system. The system shall be capable of achieving the desired sequence of operations for the proposed equipment. Additionally, the network shall have the following minimum capacity for future expansion:

d. Each Building Controller shall have routing capacity for 99 controllers.
e. The Building Controller network shall have capacity for 1000 Building Controllers.
f. The system shall have an overall capacity for 12,500 Building Controller, Advanced Application Controller, and Application Specific Controller input/output objects.

SECTION 230000 - HVAC

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SECTION 15600 – HVAC

1 PART 1 – GENERAL

1.1 REFERENCES

A. All of the Contract Documents, including General and any Supplementary Conditions and Division 1- General Requirements, apply to the work of this Section.

B. Examine all Drawings and all other Sections of the specifications for requirements herein affecting the work of this trade

C. This specification requires a preparation and submissions of drawings and other documents, procurement of approvals and provision of a complete functional HVAC system. As a result, this Section serves dual purposes of providing specifications and indicating design criteria for the HVAC Subcontractors use and guidance in preparing HVAC installation drawings and other documents for approvals.

D. The bid for work under Section 15480 shall be included with this bid.

1.2 DEFINITIONS

A. Words in the singular shall also mean and include the plural, wherever the context so indicates and words in the plural shall mean the singular, wherever the context so indicates.

B. Wherever the terms “shown on drawings” are used in the specifications. They shall mean “noted”, “indicated”, “scheduled”, “detailed”, or any other diagrammatic or written reference made on the drawings.

C. Wherever the term “provide” is used in the specifications it will mean “furnish” and “install”, “connect”, “apply”, “erect”, “construct”, or similar terms, unless otherwise indicated in the specifications.

D. Wherever the term “material” is used in the specifications it will mean any “product”, “equipment”, “device”, “assembly”, or “item” required under the Contract, as indicated by trade or brand name, manufacturer’s name, standard specification reference or other description.

E. The terms approved”, or “approval” shall mean the written approval of the Architect.

F. The term “specification” shall mean all information contained in the bound or unbound volume, including all “Contract Documents” defined therein, including all drawings.

G. The terms “directed”, “required”, “permitted”, “ordered”, “designated”, “prescribed” and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect. The terms “approved”, “acceptable”, “satisfactory” and similar words shall mean approved by, acceptable or satisfactory to the Architect. The terms “necessary”, “responsible”, “proper”, “correct” and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.

H. "Piping" includes in addition to pipe or mains, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

I. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.

J. "Exposed" means not installed underground or "concealed" as defined above.

K. "HVAC Sub-Contractor", refers to the Sub-Contractor or his Sub-Contractors responsible for furnishing and installation of all work indicated in the HVAC specifications and as shown on the HVAC drawings.

1.3 SCOPE OF WORK

A. Work Included: The scope of work, without limiting the generality thereof, consists of furnishing all labor, materials, plant, transportation, equipment, accessories, appurtenances, and services necessary and/or incidental to the proper completion of all HVAC work shown on the drawings, described in the specifications, or as reasonably inferred from either, in the opinion of the Architect, as being required, and includes, but is not limited to:

All work in Section 15600 HVAC
Coordination with DDC control vendor
Insulation
HVAC equipment
Instructions to Owner
Core drilling
Furnishing of access panels
Building automation system connections
Testing, disinfection and certification
Connections to HVAC connected equipment furnished under other sections
Valves and accessories
Cleanouts
Boilers
Record coordination drawings - CADD Submission
Thermostatic master mixing valves
Hangers, sleeves and appurtenances
Interlocking and control wiring
Cleaning and adjusting
Staging, scaffolding and rigging
Seismic restraints
Assist in commissioning of systems
Installation of fireproofing sleeves
Miscellaneous iron and steel

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. Electrical Work - Section 16100.

B. Finish Painting - Section 09900.

C. Temporary power for operation of pipe cutting, welding and threading tools - Section 01500

D. Fire Protection Work - Section 15300.

E. Heating Work - Section 15600

F. Concrete housekeeping pads - Section 03300.

G. Installation of access panels - Trades in which they occur.

H. Excavation, backfill and resurfacing - Earth Work - Section 02200.

I. Drainage structures and appurtenances - Section 02700. Beyond 10 feet.

J. Toilet accessories - Section 10800.

K. Site utilities beyond 10 feet from building

L. Furnishing of fire stop material

M. Building Commissioning

1.5 CODES, STANDARDS AND REFERENCES

A. All materials and workmanship shall comply with all applicable State Codes, Specifications, Local and State Ordinances, Industry Standards, Utility Company Regulations and latest editions.

B. In case of difference between State Building Codes, State Laws, Local Ordinances, Industry Standards, Utility Company Regulations and the Contract Documents, the HVAC Subcontractor shall promptly notify the Architect in writing of any such difference.

C. In case of conflict between the Contract Documents and the requirements of any Code, Authorities having jurisdiction, the most stringent requirements of the aforementioned shall be included in the bid and assume that will be provided unless otherwise directed by the Architect after award of Contract.

D. Should the HVAC Subcontractor perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations, he shall bear all costs arising in correcting the deficiencies, as approved by the Architect.

E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations, and the applicable requirements of the following accepted Codes and Standards, without limiting the number, as follows.

1. Local and state building, HVAC, mechanical, electrical, fire and health department codes.
2. National Fire Protection Association (NFPA)
3. Occupational Safety and Health Act (OSHA)
4. Building Owner’s Insurance Company
5. Underwriters' Laboratories (UL)

6. International Building Code 2006 (including 2006 NH Supplement)
7. Recommendations of the National Fire Protection Association (NFPA), in general and in particular: Life Safety, NFPA 101, JCAHO – Joint Commission Accreditation Healthcare, JCAHO – Interim Life

F. In these specifications, references made to the following Industry Standards and Code Bodies are intended to indicate the accepted volume or publication of the Standard. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:

1.	ANSI	American National Standards Institute
2.	ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
3.	ASME	American Society of Mechanical Engineers
4.	ASTM	American Society of Testing Materials
5.	AWS	American Welding Society
6.	CS	Commercial Standards, U.S. Department of Commerce
7.	FM	Factory Mutual
8.	NFPA	National Fire Protection Association
9.	CGA	Compressed Gas Association
10.	FS	Federal Specification, U.S. Government
11.	HI	Hydraulics Institute
12.	MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
13.	NEMA	National Electrical Manufacturers Association
14.	OSHA	Occupational Safety and Health Act
15.	UL	Underwriters' Laboratories, Inc.

G. The HVAC Subcontractor for the work shall give all necessary notices, obtain all permits, pay all governmental taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. The HVAC Subcontractor shall obtain and pay for all required Certificates of Inspection for his work and deliver same to the Architect before request for acceptance of his portion of work is made and before final payment.

1.6 GUARANTEE

A. Attention is directed to provisions of the General Conditions and Supplementary General Conditions regarding guarantees and warranties for work under this Contract.

B. Manufacturers shall provide guarantees for work under this Contract. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and the Contractor may have by Law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the systems, as determined by the Architect and shall remain in effect for a period of (12) months thereafter.

C. All materials, items of equipment and workmanship furnished under each Section shall carry the standard warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the HVAC Subcontractor including all other damage done to areas, materials and other systems resulting from this failure.

D. The HVAC Subcontractor shall guarantee that all elements of the systems provided under his Contract, are of capacity to meet the specified performance requirements as set forth herein or as indicated on the drawings.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the HVAC Subcontractor, within (5) working days, at no cost to the Owner.

F. The HVAC Subcontractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

G. Upon final acceptance of the project by the Owner, the (1) year guarantee period of all equipment and materials will be initiated. During this period, the Contractor shall make a minimum of (2) visits to the site (6) months after acceptance and immediately prior to the end of the guarantee period). These visits shall be performed in the presence of the Owner's representative. During each visit, the Contractor shall thoroughly check all equipment for proper operation and respond to any list of deficiencies prepared by the Owner. Formal reports shall be generated and forwarded to the Department of Engineering and Architect's Office describing the systems inspected, date of inspection and status of equipment.

1.7 THE SUBCONTRACTOR

A. The HVAC Subcontractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications and shall take all responsibility for and bear all losses resulting to him in the execution of his work.

B. The HVAC Subcontractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed directly or indirectly by the HVAC Subcontractor shall perform their work according to all the conditions as set forth in these specifications.

C. The HVAC Subcontractor shall furnish all materials and do all work in accordance with these specifications and any supplementary documents provided by the Architect. The work shall include every item shown on the drawings and/or required by the specifications as interpreted by the Architect. All work and materials furnished and installed shall be new and of the best quality and workmanship. The HVAC Subcontractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed

1.8 COORDINATION OF WORK

A. The HVAC Subcontractor shall compare his drawings and specifications with those of other Trades as well as the Architectural drawings and specifications, and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the HVAC work. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, HVAC Subcontractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the HVAC work caused by the HVAC Subcontractor's neglect, shall be made by him at his own expense, to the Architect's satisfaction. The HVAC Subcontractor must include in his bid sufficient dollar amounts to coordinate the work of this Contract. This project is complex and will require additional time to coordinate all Trades and allow implementation of Yale New Haven Hospital Standards and maintenance serviceability requirements. This requirement shall include, but not be limited to, producing the coordination drawings, as many times and as many drawings as required, to ensure serviceability of equipment, as approved by the Owner.

B. Locations of pipes and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. The HVAC Subcontractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component.

C. Lines which pitch shall have the right-of-way over those which do not pitch, For example: waste piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.

D. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The HVAC Subcontractor shall provide cleanouts and drains as required for his work to effect these offsets, transitions and changes in direction.

E. All work shall be installed in a way to permit removal (without damage to other parts) of coils, filters, control appurtenances, shafts, sheaves and drives and all other system components provided under this Contract requiring periodic replacement or maintenance. All piping shall be arranged in a manner to clear the openings of swinging overhead access doors as well as ceiling tiles. All work shall be done to allow easy access for maintaining equipment. The Owner and Engineer will require proof via the preparation of large scale sections and part plans that valves, cleanouts, etc. are accessible after the work is completed. Any items in the field discovered to be in non-compliance shall be removed and relocated, as required, and as directed by the Architect.

F. The Contract Drawings are diagrammatic only intending to show general runs and locations of piping, equipment, terminals and specialties and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom.

G. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, flow switches, etc., exist, such conflicts shall be reported to the Architect during bidding and prior to signing of the Contract. If such action is not taken, the HVAC Subcontractor shall furnish such items as part of his work as necessary, for complete and operable systems and equipment, as determined by the Architect.

H. The HVAC Subcontractor shall coordinate the installation of all equipment and any catwalks or service platforms provided.

I. Where drawing details, plans, specification requirements and/or scheduled equipment capacities are in conflict and where pipe sizes of same pipe are shown to be different between plans and/or between plans and sections or details, the most stringent requirement will be included in the Contract. HVAC systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.

J. Final location of all exposed control valves, access panels, fixtures, control devices, wall hydrants, hose bibbs etc., shall be coordinated with the Architectural reflected ceiling plans and/or other Architectural details, as applicable. Obtain approval of locations of all devices from Architect in the field. Equipment shown on the HVAC and/or Architectural drawings to be provided with services, shall be included under this Contract as applicable, including all piping connections to systems, to make equipment complete and operable. Additional piping, flexible fittings, etc., shall be provided to accomplish the above requirement, as required, all as part of this Contract, at no extra cost to the Owner. This requirement necessitates that the HVAC Subcontractor review the architectural drawings and the drawings of other Trades during bidding to ascertain the extent of all requirements, and interface between the Trades and scope of work.

K. The HVAC Subcontractor shall coordinate his work with other Trades' work so that all equipment and systems can be easily, safely and properly serviced and maintained. It is imperative that service personnel can safely access all equipment. Provide safety rails, steps, ladders, valve chains, handle extensions, etc. as required, in addition to the ones shown on the drawings, to ensure safe and easy access to all equipment and is provided in a manner approved by the Architect and the Owner's Project Manager

1.9 GIVING INFORMATION

A. The HVAC Subcontractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the Architect and other Contractors sufficiently in advance of the work so that all openings may be built in advance.

1.10 EQUIPMENT AND MATERIALS

A. Equipment and materials shall be delivered to the site and stored in location as directed by the Architect, in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls, filters, etc., shall be stored in dry, heated spaces.

B. The HVAC Subcontractor shall have his equipment tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned, polished thoroughly and turned over the Owner in a condition satisfactory to the Owner and Architect. Damage or defects developing before acceptance of the work shall be made good at the HVAC Subcontractor's expense.

C. The HVAC Subcontractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his Trade and shall furnish

and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.

D. The manufacturers listed within this specification establish the standards of quality required, either by description or by references to brand name, name of manufacturers or manufacturer's model number. Where one product only is specifically identified by name or manufacturer's model number, the HVAC Subcontractor shall base his bid on the use of the name product. Where multiple names are used, the HVAC Subcontractor shall base his bid on the use of any of those products named. The HVAC Subcontractor shall submit with his bid, the names of products which are proposed as substitutions for products named in the specifications. Each proposed substitution shall be accompanied by a written statement of money to be added or deducted from his bid. The Owner reserves the sole right to accept or reject said substitutions with or without cause. When equipment and/or materials are proposed to be purchased from a manufacturer other than those specified, the HVAC Subcontractor shall provide with his bid, data sufficient to inform the Owner and Engineer of the basis of equality of the substitution to that of the equipment and/or materials specified. When equipment other than that specified is used, the HVAC Subcontractor shall be solely responsible for any extra cost of required revisions such as structural steel, concrete, electrical, piping, and any engineering review, coordination with other Trades, or redesign, etc. Such additional cost shall be identified at the time such substitutions are proposed and incurred by the HVAC Subcontractor.

E. Manufacturers' directions shall be followed completely in the delivery, storage, protection and installation of any equipment. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's written instructions before proceeding with the work. Should the HVAC Subcontractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.

F. The HVAC Subcontractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.

F. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of the HVAC Subcontractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, the HVAC Subcontractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the HVAC Subcontractor shall make all necessary changes in all affected related work provided under other Sections including location of roughing-in connections by other Trades, electrical requirements, piping, supports, insulation, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.

H. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. Equipment and materials shall be products which will meet with the acceptance of the Authorities having jurisdiction over the work and as specified hereinbefore. Where such acceptance is contingent upon having the products listed or labeled by FM, UL or other testing laboratories, the products shall be so listed or labeled. Where no specific indication as to the type or quality of material or equipment is indicated, a first class standard article shall be provided.

I. All equipment of one type (such as valves, piping, heaters, well water system components, drainage specialties, etc.), shall be the product of one manufacturer.

J. Equipment furnished by the Owner, if assigned to the HVAC Subcontractors, shall be received, inspected, installed, etc., as if they were purchased by the HVAC Subcontractor. All guarantees, service contracts, etc., shall be the same as for all other equipment provided under this Contract. Make all connections, and provide all piping and controls as necessary.

1.11 CUTTING AND PATCHING

A. The HVAC Subcontractor shall be responsible for all core drilling, as required for work under his Contract, but in no case shall he cut into any structural elements without the written approval of the Architect.

B. All cutting, rough patching and finish patching shall be provided under this Contract.

C. All concrete and masonry equipment bases and pads shall be provided by the Other Work Contractor.

1.12 USE OF PREMISES

A. The HVAC Subcontractor shall confine all of his apparatus, storage of materials and construction to the limits indicated on the drawings and directed by the Architect and he shall not encumber the premises with his materials.

B. In storing materials within areas (structure or ground), or when used as a shop, the HVAC Subcontractor shall consult with the other work Contractor and shall restrict his storage to space designated for such purposes. The HVAC Subcontractor will be held responsible for repairs, patching or cleaning arising from any unauthorized use of premises.

C. Notwithstanding any approvals or instructions which must be obtained by the HVAC Subcontractor from the Architect in connection with use of premises, the responsibility for the safe working conditions at the site shall remain the HVAC Subcontractor's and the Architect or Owner shall not be deemed to have any responsibility or liability in connection therewith.

1.13 PROTECTION

A. All materials such as valves, fittings, piping, etc., shall be properly protected and all piping openings shall be temporarily closed by the HVAC Subcontractor installing same, so to prevent obstruction and damage. The HVAC Subcontractor shall take precautions to protect his materials from damage and theft.

B. The HVAC Subcontractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or electrical systems provided under his Contract.

1.14 DAMAGE TO OTHER WORK

A. The HVAC Subcontractor shall be held responsible and shall pay for all damages caused by his work to the new building structures and equipment, piping, etc., and all work and finishes installed under this Contract in the new or in existing building. Repair of such damage shall be done as hereinbefore specified, at the expense of the HVAC Subcontractor and to the Architect's satisfaction.

1.15 CORRECTION OF WORK

A. The HVAC Subcontractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after completion of work and whether or not fabricated, installed or completed. The HVAC Subcontractor shall bear all costs of correcting such rejected work.

B. The above requirements will also apply to work observed to be in conflict with 15400-1.8 "Coordination of Work" as it relates to installations not allowing accessibility to all system components.

1.16 EXTRA WORK

A. No claim for extra work will be allowed unless it is authorized by the Architect in writing before commencement of the extra said work.

1.17 TOUCH-UP PAINTING

A. The HVAC Subcontractor shall thoroughly clean all equipment and systems provided under this Contract from rust, splatters and other foreign matter or discoloration, leaving every part of each system in an acceptable prime condition. The HVAC Subcontractor, for the work under his Contract, shall refinish and restore to the original condition all equipment and piping which has sustained damage to the manufacturer's prime and finish coats of paint and/or enamel.

1.18 PIPE SLEEVES, PLATES AND ESCUTCHEONS, FIRESTOPPING AND SMOKEPROOFING

A. Where pipes pass through all walls and floors, the HVAC Subcontractor shall provide and set individual sleeves for each pipe and all other work under his charge, as necessary for passage of all pipes. Sleeves shall be of sufficient size to provide 1/2" air space around the pipe passing through (including insulation where pipes are insulated). Where pipes are to be insulated, insulation shall run continuous through sleeves. All openings shall be sealed, smokeproofed and made tight. The HVAC Subcontractor shall be responsible for the exact location of sleeves provided under this Contract and shall coordinate all requirements for piping sleeves.

B. The HVAC Subcontractor, for work under his charge, shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation, and he shall prepare sleeving and opening drawings for the use of these drawings by the other work contractor.

C. Sleeves and inserts shall not be used in any portions of the building, where their use would impair the strength or construction features of the building. Elimination of sleeves must be approved by the Architect.

D. Provide chrome-plated brass escutcheons with set screw for exposed piping, in all areas except in mechanical rooms. In these areas use plain brass or cast iron escutcheons suitable for painting. All escutcheons shall be sized to fit the bare pipe or insulation in a snug and neat manner. They shall be of sufficient size to cover sleeved openings for the pipes and of sufficient depth to cover sleeves projecting above floors. Escutcheons shall be as manufactured by Beaton & Caldwell, Dearborn Brass or Grinnell.

E. Pipe sleeves shall be required on all pipes passing through all walls and shall be made of Schedule 40 pipe, 16 gauge galvanized steel or 16 gauge steel as follows:

1. Sleeves on pipes passing through masonry or concrete construction shall be Schedule 40 pipe.
2. Sleeves on pipes passing through drywall construction shall be 20 gauge galvanized steel.
3. Sleeves on pipes passing through fire rated drywall partitions shall be 16 gauge steel.
4. Exterior wall sleeve through masonry walls shall be made watertight by the use of Mechanical Link Seal Joint as MFG by Century Products MFG.

F. Pipe sleeves shall be set as follows:

1. Set sleeves 1" above finish floor (3" at penthouses and mechanical rooms) and flush on each side of walls, except sleeves through floor occurring in walls and partitions shall terminate 1" above the finished floor.
2. Sleeves shall be set securely in place before concrete is poured.

G. The HVAC Subcontractor shall firestop or smokestop the space between the sleeves provided under his Contract and pipes as applicable, as follows:

1. Materials shall bear label issued by qualified laboratory and specifically indicating that the product has been tested to ASTM E814 Standard, shall be as manufactured by Bio Fireshield Inc. or Dow Corning Corp., and shall include the following:
   a. Dow Corning silicone RTV foam (penetration fill material) complete.
   b. Dow Corning 96-081 RTV silicone adhesive sealant.
   c. Mineral fiber board, mineral fiber matting, and mineral fiber putty may be utilized for forming and damming materials used to contain the liquid silicone RTV foam mixture prior to and during foam-filling penetrations. Damming and forming materials shall be fire tested and functionally approved and shall be capable of being left in place to become an integral part of the foamed penetration wall.

2. Materials shall be delivered in their original, tightly sealed containers or unopened packages, all clearly labeled with the manufacturer's name, product identification and lot numbers where appropriate.

3. Installation shall comply with the following:
   a. Penetration seal preparation shall include use of the procedures, techniques and quality control standards recommended by the product manufacturer, as follows:
   b. Remove all incidental combustible materials and loose impediment from the penetration opening and involved surfaces.
   c. Remove free liquids or oil from all involved surfaces and penetration components.
   d. Install the specified damming materials to accommodate and insure the proper thickness/fire rating requirements and provide containment during foaming.
   e. Foam mixing and dispensing of equipment and materials shall be in strict accordance with manufacturer's instructions.
4. The materials installation procedures, clean-up, safety precautions and requirements shall be in accordance with Dow Corning published information relative to "Safe Handling Procedures", use of safety shoes, goggles, etc.

5. All firestopping materials must be applied in direct accordance with their UL label certification.

6. The HVAC Subcontractor shall submit a mockup of every type of firestopping method used on this project for approval by the Architect at the site. The firestopping methods must be approved prior to installation of systems.

H. Except as otherwise specified, underground piping passing through exterior walls, foundation slabs on grade, or manhole walls, shall have penetration closures of the modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous belt around the pipe and with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between the pipe and wall, reducing chances of cathodic reaction between these members. The HVAC Subcontractor for work under his charge shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation. The inside diameter of the wall opening shall be sized to fit the pipe and ensure a watertight joint. Where applicable, when installing seals, take into account the pipe O.D. if non-standard due to coating or jacketing.

1.19 WATERPROOFING, FLASHING AND COUNTERFLASHING

A. Unless specifically indicated otherwise on the drawings, the HVAC Subcontractor shall provide all counterflashing and waterproofing of all piping and equipment provided by him, which pierce roofs, walls and other weatherbarrier surfaces. All work under this Section shall be coordinated with the Other Work Contractor.

B. All work shall be performed in a workmanlike manner to ensure weatherproof installation. Any leaks developed due to this Contractor's work shall be repaired at his expense, to the Architect's satisfaction.

C. Pipes passing through slabs shall have the sleeve extended above floors as hereinbefore specified to retain any water and the space between the pipe and sleeve caulked with lead wool. The top shall be sealed with lead and the bottom shall be sealed with monolastic caulking compound.

C. Subcontractor shall provide and install counterflashing to overlap the base flashing by 4". Flashing shall be fastened with matching clamp rings or by brazing, welding or soldering.

1.20 MISCELLANEOUS IRON AND STEEL

A. The HVAC Subcontractor shall provide all steel supports and hangers as shown on the drawings or required to support all equipment, systems or materials provided under this Contract.

B. All work shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets and framework shall be properly sized and strongly constructed.

C. Measurements shall be taken on the job and worked out to suit adjoining and connecting work. All work shall be done by experienced metal-working mechanics. Members shall be straight, true and accurately fitted.

D. Welded joints shall be ground smooth where exposed. Drilling, cutting and fitting shall be done as required to properly install the work and accommodate the work of other Trades as directed by them.

E. Members shall be generally welded except that bolting may be used for field assembly where welding would be impractical. Welders shall be skilled and certified. Bolts, nuts and washers shall be high tensile type, minimum 3/4" diameter, conforming to ASTM.

F. All shop and field fabricated iron and steel work shall be cleaned and dried and given (1) coat of rust inhibiting paint on all surfaces and in all openings and crevices.

1.21 ELECTRICAL WORK, MOTORS, MOTOR CONTROLLERS

A. The Electrical Subcontractor shall provide power wiring to all equipment provided under Section 15600. All control wiring shall be installed in conduits and in accordance with the respective equipment manufacturer requirements. All connections shall be provided by the HVAC Subcontractor. All conduit and wiring provided by the HVAC Subcontractor shall be installed in accordance with the requirements of Section 16100 of these Specifications.

B. Motors shall be built in accordance with latest Standards of NEMA and as specified. Motors shall be specifically and expressly wound for voltage required.

C. Motors shall be tested in accordance with ANSI 50 and conform thereto for insulation resistance and dielectric strength.

D. Motors shall be provided with adequate starting and protective equipment as specified or required and with conduit terminal box of size adequate to accommodate conduits and wires.

E. Capacity shall be sufficient to operate motors under job conditions of operation and load, without overload and shall be at least the horsepower size indicated or specified.

F. All motors shall be suitable for continuous duty at rated horsepower, with temperature rise not to exceed 40°C for dripproof motors, 50°C for splashproof motors, 55°C for totally enclosed motors. All motors shall be capable of 15% overload without overheating.

G. Direct connected motors shall be furnished with adjustable base. Motors connected to driven equipment by belt or shaft shall be furnished with adjustable sliding bases, except for fractional motors which shall be furnished with slotted mounting holes.

H. Motors smaller than 1/2 HP shall be capacitor, starter or split-phase type. Motors 1/2 HP and larger shall be squirrel cage, induction type. Motors 1 HP and larger shall have grease lubricated ball bearings and approved grease fittings.

I. All electrical apparatus and controls furnished as a part of the HVAC work shall conform to applicable requirements under Electrical Section.

J. The HVAC Subcontractor shall provide the Electrical Subcontractor with all motor size and wiring requirements within (15) days from date of Contract to allow proper coordination of Trades by the other work Contractor.

K. The HVAC Subcontractor shall verify with the Electrical Subcontractor available electrical characteristics before ordering any equipment or motors.

L. Equipment which includes a number of correlated electrical control devices mounted in a single enclosure or on a common base with equipment, shall be supplied for installation completely wired internally with terminal strip ready for external wiring. Unless specifically directed otherwise in the Contract Documents, if these control devices are separately mounted they shall be furnished by the HVAC Subcontractor and wired by Electrical Subcontractor in accordance with the manufacturer's wiring diagram, as shown on the drawings and as specified hereinafter.

1.22 IDENTIFICATION OF MATERIALS

A. All equipment used in the HVAC systems shall have a permanently attached nameplate identifying the manufacturer, service, size, serial number or model number, etc. The nameplates shall be kept clean and readable at all times.

B. Each item of equipment such as pumps, air compressors, vacuum pumps, etc., shall be identified by a permanently attached nameplate made of black surface, white core laminated bakelite with 1" high indented letters. Nameplates shall be minimum 5" long by 3" wide and bear the equipment name as designated in the specifications. Nameplates shall be as fabricated by Seton Nameplate Co., Atlantic Engraving Co., W.H. Brady Co., or approved equal. Attach with screws or rivets only.

C. A legend showing the service and an arrow indicating the direction of flow shall be applied on each pipe installed by the HVAC Subcontractor. Indication shall be by stencil and paint only, no "stick-ons" will be allowed.

D. The piping of each system shall be identified in the following locations and where directed by the Architect.

1. Pipe mains and branches - every 15’-0”.
2. At each valve.
3. Each wall penetration (both sides).
4. Each riser including branch risers from mains.
5. At each piece of equipment.

E. The identification of piping shall be coordinated with the Owner and comply with OSHA and ANSI A13.1 Standards for the identification of systems. Obtain approval of Architect prior to installation. The letter size and background color shall conform to the ANSI Scheme for the Identification of Piping Systems.

F. Provide all labels on all vents thru roof.

G. Close attention shall be paid to all vent vent piping including that piping which penetrates roof. - This piping must be identified, including all vent penetration through the roof.

1.23 VALVE TAGS, NAMEPLATES AND CHARTS

A. All valves on pipes of every description shall be provided with neat circular brass valve tags of at least 1 1/2" in diameter, attached with brass hook to each valve stem or handle as determined by Architect. Tags shall be provided by the HVAC Subcontractor for the work under his charge. Stamp on these valve tags, in letters as large as practical, the number of the valve and the service, such as "HW", "HWC", "CW", ", for hot water, hot water circulation, cold water. The numbers of each service shall be consecutive. Obtain approval of Architect prior to installation. All pipe system valves to be tagged.

B. All valves on equipment shall be numbered by 3" red metal discs with 2" high white numbers secured to stem of valves by means of brass hooks or small link brass chain.

C. These numbers shall correspond to numbers indicated for valves on the Record Drawings and on (2) printed detailed lists. These printed lists shall state the numbers and locations of each valve and the equipment or system which it controls and other necessary information such as requiring the opening or closing of another valve or valves when any one valve is to be opened and closed.

D. These printed lists shall be prepared in form to meet approval of the Architect and shall be framed under glass. Provide valve lists in booklet form also and submit (6) copies to the Architect.

E. Nameplates, catalog numbers and rating identification shall be securely attached to mechanical equipment with screws or rivets. Adhesives or cements will not be permitted.

F. The HVAC Subcontractor shall provide for his work all valve charts including his name and telephone number; date of chart; name and telephone number of Architectural Firm and Consulting Mechanical Engineering Firm and the Owner's representative.

G. This information must be submitted on electronic file format also.

1.24 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

A. The HVAC Subcontractor shall thoroughly instruct the Owner's operating personnel, to the complete satisfaction of the Architect, in the proper operation of all systems and equipment provided by him. The HVAC Subcontractor shall make arrangements, via the Other Work Contractor, as to whom the instructions are to be given in the operation of the basic and auxiliary systems and the periods of time in which they are to be given. The Architect and Owner shall be completely satisfied that the Owner's representative has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by the HVAC Subcontractor to the Owner's representative, then the HVAC Subcontractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this paragraph of the specification has been complied with. All time required for Owner's instruction to satisfy the above requirements shall be included in this Contract. No extra compensation for such instructions will be allowed.

B. The HVAC Subcontractor shall submit to the Architect for approval, a total of (6) typed sets, bound neatly in 3-ring loose-leaf binders, of all instructions for the installation, operation, care and maintenance of all equipment and systems. Information shall indicate possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each section such as valves, water boosters, pure water systems, etc., shall be clearly divided from the other sections. A sub-index for each section shall also be provided. The methodology of setting-up the manuals shall be submitted to the Architect and Owner through the Contractor for approval prior to final submission of manuals.

C. The instructions shall contain information deemed necessary by the Architect and shall include, but not be limited, to the following:

1. Instructional classes on equipment and systems operation for Owner's representative and maintenance personnel, by engineering staff of HVAC Subcontractor. Minimum of ten (10) hours of instruction. Instruction shall include:

   a. Explanation of manual and its use.
   b. Summary description of the HVAC systems.
   c. Purpose of systems.

   All training classes and equipment instruction shall be videotaped on VHS format by the HVAC Subcontractor. Provide (3) copies of all tapes to the Owner and one to the Architect. At the Owner's discretion, the HVAC Subcontractor provide ten (10) additional hours of instructions up to one year after the building has been occupied.

2. System

   a. Detailed description of all systems.
   b. Illustrations, schematics, block diagrams, catalog cuts and other exhibits.

3. Operations

   a. Complete detailed, step-by-step, sequential description of all phases of operation for all portions of the systems, including start-up, shutdown, adjusting and balancing. Include all posted instruction charts.

4. Maintenance

   a. Parts list and part numbers.
   b. Maintenance, lubrication and replacement charts and Contractor's recommendations for preventive maintenance, as applicable to his work.
   c. Troubleshooting charts for systems and components.
   d. Instructions for testing each type of part.
   e. Recommended list of on-hand spare parts.
   f. Complete calibration instructions for all parts and entire systems.
   g. Instruction for charging, filling, draining and purging, as applicable.
   h. General or miscellaneous maintenance notes.

5. Manufacturer's Literature

   a. Complete listing for all parts.
   b. Names, addresses and telephone numbers.
   c. Care and operation.
   d. All and only pertinent brochures, illustrations, drawings, cuts, bulletins, technical data, certified performance charts and other literature with the model actually furnished to be clearly and conspicuously identified.
   e. Internal wiring diagrams and engineering data sheets for all items and/or equipment furnished under each Contract.
   f. Guarantee and warranty data.

6. The HVAC Subcontractor shall furnish instructions for lubricating each piece of equipment installed by him. Instructions shall state type of lubricant, where and how frequently lubrication is required. Frame instructions under glass and hang in a location as directed by Architect.

7. Information must be submitted on electronic file also

1.25 MANUFACTURER'S REPRESENTATIVE

A. The HVAC Subcontractor shall provide, at appropriate time or as directed by the Architect, the on-site services of a competent factory trained Engineer or authorized representative of particular manufacturer of equipment such as for the domestic water booster pump, ejectors, hot water heater, pumps, etc., provided under this Contract, to instruct the Owner, inspect, adjust and place in proper operating condition any item provided by him, as applicable. A minimum, system start-up shall start 90 days prior to scheduled building occupancy or at construction managers discretion.

B. The HVAC Subcontractor, as applicable, shall start-up and set in operating condition all major equipment and systems, such as the domestic water booster pump, water heaters, ejectors, well water pumps, etc., in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. In no case will major systems and equipment be activated by any of the Subcontractor's, without the assistance or presence of the equipment manufacturer representative.

C. A written report shall be issued by the particular equipment manufacturer and the HVAC Subcontractor summarizing the results of the commissioning and performance of each system for the Architect's record. No additional compensation will be allowed for any Contractor for such services.

1.26 CONNECTIONS TO EQUIPMENT

A. The HVAC Subcontractor shall provide all pipe connections to equipment provided under other Sections of the specifications as shown on the Architectural Planning, and/or HVAC drawings and herein specified (sterilizers, autoclaves, ice machines etc.), including final connections to equipment, to result in a complete system, fully operational. The HVAC Subcontractor shall also make connections to Owner furnished or relocated equipment as specified above. Coordinate location of all equipment with Architect and Other Work Contractor. Obtain installation diagrams and methods of installation of all equipment, from manufacturers. Follow instructions strictly. If additional information is required, obtain same from Architect.

1.27 COORDINATION DRAWINGS

A. Before materials are purchased, fabricated or work is begun, each Subcontractor shall prepare coordination drawings for all floors/areas, including buried systems/services (all-Trade-composite at 3/8 inch scale), showing the size and location of his equipment and lines, in the manner described herein under General Requirements - Section 01040.

B. Coordination drawings are for the architect’s use during construction and shall not be construed as shop drawings or as replacing and shop drawings. The coordination drawings, when corrected for actual “as-built” conditions, will be reviewed by the Architect, corrected and become the Record Drawings to be submitted to the Owner for his use.

C. The cost of producing and reproducing the drawings will be included under the Contract of each Trade, including the cost or preparation of the Architectural building outlines. The Contractor shall take the lead to produce the Architectural backgrounds, show all ductwork, piping, etc., and circulate the drawings to any of his Subcontractors and the other Trades (HVAC, Fire Protection, Electrical), so that they can indicate all their work as directed by the Architect as required, to result in a fully coordinated installation.

D. In addition to the regular coordination drawing review, the HVAC work will also be reviewed by the Architect/Engineer to ensure that the system and equipment arrangements are suitable to provide maintenance access and service as follows:

1. Valves and instrumentation should be grouped where possible and positioned in accessible locations.

D.Prepare a complete set of computer based AutoCad 2005 drawings at scale not less than 3/8" equals 1'-0", showing basic layout for the structure and other information as needed for preparation of Coordination Drawings. The drawings shall indicate the layout of all specialty tradework as indicated herein and shall be designated as Coordination Drawings. The Contractors can purchase a copy of the floor plans on disk from the engineer to assist in the preparation of Coordination Drawings. The Contractor shall provide a minimum of two (2) weeks notice to the engineer for the preparation of the disk. A signed liability release form will be required from the Contractor prior to the release of the disk from the engineer.

F. Highlight all fire rated partitions on the Coordination Drawings for appropriate coordination.

G. The main paths for the installation or removal of equipment from mechanical and electrical rooms shall be clearly indicated on the Coordination Drawings.

H. Each of the specialty trades shall add its work to the base drawings with appropriate elevations and grid dimensions. Specialty trade information shall be required for mechanical rooms, horizontal exits from HVAC closets, crossovers and for spaces in the above ceilings where congestion of work may occur such as corridors and, where required, entire floors. Drawings shall indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions and other services. Indicate elevations relative to finish floor for bottom of ductwork and piping and conduit 6" greater in diameter.

1. Specialty Trade shall include:

a. HVAC system.
b. piping and equipment
c. Electrical
d. Sheet Metal Work
e. Sprinkler System
f. ATC system
g. Medical gas/vacuum

I. Upon completing their portion of the Coordination Drawings, each specialty trade shall sign, date and return Coordination Drawings to the Contractor.

J. Where conflicts occur with placement of materials of various trades, the General Contractor shall be responsible to coordinate the available space to accommodate all trades. Any resulting

adjustments shall be initialized and dated by the affected specialty trade subcontractor. The General Contractor shall then final date and sign each drawing.

K. Fabrication shall not start until Coordinate Drawings have been distributed to all parties as indicated herein.

L. Format: Coordination Drawings (plans only) shall be done using CAD in AutoCAD 2005 in either IBM or Mac Format, disks shall be given tot he architect for future transfer to Owner. Coordination Drawings will be used as base for as-built drawings.

M. Distribution of Coordination Drawings:

1. The General Contractor shall provide one print of each Coordination Drawing to:

    a. Each specialty trade Subcontractor.
    b. Owner
    c. Construction Manager
    d. Architect (for record purposes).

N. After distribution:

1. The method used to resolve interferences not previously identified shall be as in paragraph F. above. Distribute revised Coordination Drawings to all parties listed above.

O. Coordination Drawings include but are not necessarily limited to:

1. Structure
2. Partition/room layout, including indication of smoke and fire resistance rated partitions.
3. Ceiling layout and heights
4. Light fixtures.
5. Access Panels
6. Sheet metal, heating cols, boxes, grilles, diffusers, etc.
7. All heating piping and valves.
8. Smoke and fire dampers.
9. Soil, waste, vent piping, and conductor
10. All water systems.
11. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit. Motor control centers, starters and disconnects.
12. Sprinkler piping and heads.
13. All equipment, including items in the Contract as well as O.F.C.I. and O.F.I. items.
14. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur indicates areas in which the required access area may be greater than the suspected grid systems.
15. Medical Gas Systems

1.28 RECORD DRAWINGS

A. The HVAC Subcontractor shall maintain current at the site a set of his drawings on which he shall accurately show the actual installation of all work provided under his Contract indicating any variation from the Contract Drawings, in accordance with the General Conditions and Supplementary General Conditions. Changes whether resulting from formal change orders or other instructions issued by the Architect shall be recorded. Include changes in sizes, location and dimensions of piping, equipment, etc.

B. Utilizing the coordination drawings described herein before, the HVAC Subcontractor shall modify/correct/edit the HVAC work on the above CAD coordination drawings, to obtain a "CAD" set of Record Drawings. Also include (2) blackline prints, and CDX CAD files of entire record drawings..

C. A marked-up and colored-up set of prints on-site will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner's representatives and they shall be corrected if found either inaccurate or incomplete. This procedure is mandatory.

D. Coordination drawings are for the Contractor's, Architects and Owner's use during construction and shall not be construed as replacing any shop drawings. The CAD coordination drawings, when corrected for actual "as-built" conditions, will be reviewed by the Architect, corrected and will be used to formulate the Record Drawings to be submitted to the Owner for his use.

E. The HVAC Subcontractor shall submit a set of CAD files on disc marked "AS-BUILTS". All costs associated with the production and reproduction of the CAD files shall be included under the HVAC bid for work under the HVAC contracts.

1.29 ELECTRICAL ROOM REQUIREMENTS

A. The HVAC Subcontractor shall not install any piping or equipment in or through electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms, unless piping or equipment is intended to serve these rooms. If the HVAC Subcontractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.

B. Where piping carrying liquid or gas is routed to within 12" of any electrical panels or packaged equipment controllers, the HVAC Subcontractor shall provide galvanized sheet metal drain pans below such piping. The drain pans shall be constructed of minimum 18 gauge G-90 galvanized sheet metal with all joints sealed watertight. Extend 1 1/4" copper drain piping, with dielectric union to nearest floor drain.

1.30 HOISTING EQUIPMENT AND MACHINERY

A. All hoisting equipment and machinery required for the proper and expeditious prosecution and progress of the work under this Contract shall be furnished, installed, operated and maintained in safe condition by the HVAC Subcontractor for his material and/or equipment delivered to the designated hoisting area. All costs for hoisting operating services shall be borne by the HVAC Subcontractor, for all equipment and work under his charge.

1.31 STAGING

A. All staging, exterior and interior for HVAC work shall be furnished and erected by the HVAC Subcontractor and maintained in safe condition by him for proper execution of his work.

1.32 SUBMITTALS

A. Prepare and submit shop drawings in accordance with the requirements hereinbefore specified, and of Division 0 and applicable parts of Division 1 and in the manner described therein, modified as noted hereinafter.

B. All shop drawings shall have clearly marked the appropriate specification number, drawing designation, project name, etc., for identification of the submittal.

C. Disposition of shop drawings shall not relieve the HVAC Subcontractor from the responsibility for deviations from the drawings or specifications, unless he has submitted in writing a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Architect, nor shall such disposition of shop drawings relieve the HVAC Subcontractor from responsibility for error in shop drawings or schedules.

D. HVAC contractor shall provide all submittals and shop drawings as noted in the HVAC specifications and receive approvals before ordering equipment.

E. HVAC contractor scope shall include all ATC work, whether done directly or by a separate entity sub contracted by the HVAC contractor. This scope includes providing all submittals, shop drawings, schematics, sequences, equipment cuts, etc. This scope includes integrating the HVAC equipment with the ATC system for a fully functional system and commissioning all as a working package.

F. HVAC contractor scope shall include all air and water balancing, whether done directly or by a separate entity sub contracted by the HVAC contractor. The test, adjust and balancing shall include all certifications and requirements noted in the specifications and such certifications shall be provided as a submittal along with all other HVAC submittals and shop drawings.

G. Shop drawing data shall include, but not be limited to, the following:

1. Manufacturer's model and catalog data.
2. Complete connection diagrams for all Trades.
3. Dimensions, capacities, ratings, materials, finishes, etc.

H. Each shop drawing is required to bear the review stamp of each Contractor associated with installing the equipment and/or processing the document.

I. Shop drawings shall include, but shall not be limited to, the following:

1. HVAC work layout, including location and sizes of piping, valves, drains, and all other accessories.
2. Equipment Cuts For:

    a. Valves, gauges, piping
    b. Hangers, supports, insulation, and identification.

c. Access panel
d. HVAC circulation pumps.
e. Insulation
f. Seismic bracing
j. Piping
k. Heat tracing
m. HVAC equipments

1.33 CROSS AND INTERCONNECTIONS

A. No HVAC equipment, device or piping shall be installed which will provide a cross or interconnection between a distributing supply or return system.

1.34 CORE DRILLING

A. This subcontractor shall perform all core drilling required for the proper installation of the HVAC system. Locate all required openings and prior to coring coordinate the opening with the General Contractor. All other openings are by the General Contractor.

B. All core drilling locations must be approved by the Owner.

1.35 COMMISSIONING OF HVAC SYSTEMS

A. Commissioning of systems to be provided by authorized commissioning agent and not this sub-contractor. Commissioning of systems to be as directed by owner. Commissioning of selected systems shall be provided by and secured by owner. Refer to Section 18000 of General Specifications.

B. The HVAC Contractor shall provide 3 days (8 hrs) per each system to assist the commissioning agent in their procedures.
1.Refer to Commissioning Section 18000 in General Specification.

2 PART 2-PRODUCTS

2.1 MATERIALS

A. All materials, except as otherwise specified, shall be new, of current production, first quality and the best of each class specified.

B. Required materials not covered by detailed specifications shall be of a suitable class, grade, quality and type and shall be subject to the approval of the Architect. Where two or more units of the same class of equipment are required, these units shall be the products of a single manufacturer.

C. All equipment shall be installed and constructed to operate safely, as designed, without leakage, undue wear, noise, vibration or corrosion.

D. All products used in this project installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's Representative in writing. Spare parts shall be available for at least five years after completion of this contract.

2.2 ELECTRIC MOTORS AND RELAYS

A. Design, type and ratings of electric motors shall comply with the National Electrical Code, NEMA and Underwriter's Laboratory.

B. Unless otherwise noted or required for special applications, motors shall be open drip-proof with sealed ball bearings.

C. All electric motors shall be of the voltage, type and frame as specified in the electrical portion of the specifications.

2.3 ACROSS-THE-LINE STARTERS

A. All motor starters shall be across-the-line start with magnetic contactors and thermal overloads properly sized for the motor nameplate data.

B. All motor starters shall be furnished with a Hand-Off-Auto (HOA) switch mounted on the cover of the enclosure.

C. All motor starters shall be furnished with a fused 120 volt control power transformer rated at a minimum of 2 amps.

D. All motor starters shall be furnished mounted in a NEMA 1 enclosure suitable for the mounting location.

E. All motor starters shall be provided with magnetic contactors having one normally open and one normally closed auxiliary contactor

F.Motor starter shall be furnished by HVAC contractor and installed by Electrical contractor.

2.4 SEISMIC BRACING

A. The HVAC Subcontractor shall provide all necessary design and materials for seismic restraint and protection of piping, Duct work and devices against damage where subject to earthquakes as required for the entire HVAC system within the building. All isolation and seismic devices shall be the product of a single manufacturer. Products of other manufacturers are acceptable provided their systems strictly comply with this section of the specifications. Provide isolation materials and seismic restraints complete and as manufactured by Mason Industries, Tolco or approved equal.

The work under this section shall include the design, furnishing and installation of all restraint devices and systems as may be required for the HVAC system including, but not necessarily limited to, the following:

1. All HVAC equipment and devices such as Roof top units, Boilers, pumps, air handlers, VAV Boxes, tanks, etc.
2. All HVAC system piping as required.
3. All HVAC system ducting as required.
3. Piping and duct penetrations through floors and walls.
4. Sleeves with clearances around the outside, as recommended.
5. Equipment isolation bases.
6. Piping and duct flexible connectors.
7. Seismic restraints for isolated equipment.
8. Seismic restraints for non-isolated equipment.
9. Certification of seismic restraint designs.

B. Submit ten (7) copies of descriptive data for all products and materials, including the following:

1. Catalog cuts and data sheets for the specific isolators, restraints and all other items to be utilized.
2. Details of methods of sleeving, HVAC, smokeproofing and isolation for pipes and ducts penetrating walls and slabs.
3. Specific details of seismic restraints and anchors, including number, size and locations for each piece of equipment.
4. Calculations to support seismic restraint designs.
5. All calculations, details and other submittal materials shall be sealed and signed by a structural or civil engineer registered in the state and qualified to perform seismic design calculations.
6. A seismic design liability insurance certificate that must accompany all submittals.

C. Code and standards requirements shall include, but not be limited to:

1. Applicable IBC with any additional State or Local requirements.
2. All State and Local codes.

C.Manufacturers working in this section must provide a seismic design liability insurance certificate and certify their ability to provide engineering and design as required by this section. This certificate shall be submitted to the Architect for review prior to any submittals.

2.5 HANGERS AND SUPPORTS

A. Pipe hanger or stanchion support assemblies shall include turnbuckles or other means of vertical adjustment.

B. Trapeze hangers may be used in lieu of separate hangers for closely spaced, parallel lines. Pipe hanger components shall be as per MSS SP-58.

C. Hangers shall have steel rods with two nuts and shall be suspended from suitable beam clamps or concrete inserts. Rod sizes shall be as recommended by the hanger manufacturer and at least the following:

1. Pipe to 2" .....3/8" diameter
2. 2½" - 3".....1/2" diameter
3. 4- 5" .....5/8" diameter

D. Maximum hanger or stanchion support spacing for copper or steel pipe shall be as follows:

PIPE SIZE	MAX SPACING	PIPE SIZE	MAX SPACING	PIPE SIZE	MAX SPACING
3/4” or less	5 feet	2 ½"	9 feet	6"	14 feet
1”	6 feet	3"	10 feet	8"	16 feet
1¼"	7 feet	3 ½"	11 feet	10"	18 feet
1½"	8 feet	4"	12 feet	12"	19 feet
2”	8 feet	5"	13 feet	14"	25 feet

E. Hangers or stanchion supports for copper tubing shall be copper plated where they contact the copper tubing.

F.Hangers or stanchion supports for insulated pipe shall have insulation shields.

G. All rigid piping attached to the building and serving equipment subject to vibration shall be hung or supported on vibration isolators for the first 20 feet.

H. Vertical rises shall be supported from stands at the bottom of the rise or hangers at the top of the rise as shown on the drawings per the Contractor's option.

2.6 ANCHORS

H. Anchor points as shown on the drawings or as required shall be located and constructed to permit the piping system to take up its expansion and contraction freely in opposite directions away from the anchored points.

1. Make proper provision for expansion and contraction in all parts of hot water and steam piping systems wherever possible by means of pipe bends, pipe offsets, swing connections or changes in direction of piping.

I. Where piping network cannot be employed to absorb expansion and contraction in the piping systems, provide expansion joint compensators. Use of expansion compensators in non-accessible locations shall not be permitted.

1. All mains and risers having expansion offsets or compensators shall be securely anchored to the building construction in such a manner as to throw all expansion towards the offsets or joints. The HVAC Contractor shall be responsible for any additional structural members that may be required for proper installation of hangers, anchors, guides and supports.

2.7 VIBRATION ISOLATORS

A. Double deflection neoprene mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Boltholes shall be provided for these areas where bolting is required.

B. Spring type isolators shall be free standing and laterally stable without any housing and complete with ½" neoprene acoustical friction pads between the baseboard and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 80% of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections, compressed spring height and solid spring height.

C. Vibration hangers for piping and mechanical equipment shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bussing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through an arc of 30° before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing showing the 30° swing capability. For locations requiring precise elevation during installation the hanger shall be precompressed to the rated deflection and the released after completion of the installation.

D. Vibration hangers for duct systems shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through an arc of 30° before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing showing the 30° swing capability.

E. Horizontal thrust restraints shall be provided on equipment subject to excessive displacement. The horizontal thrust restraint shall consist of a spring element in series with a neoprene pad. The spring element shall be contained within a steel frame and designed so that it can be preset for thrust and adjusted to allow for a maximum of ¼" movement when the equipment starts or stops. The assembly shall be furnished with one rod and angle brackets for attachment to the equipment and the ductwork. Horizontal thrust restraints shall be attached at the centerline of the thrust and symmetrically on each side of

the unit.

2.8 PIPING INSULATION MATERIALS

A. Insulation for pipe shall be glass fiber with a K factor of .24 at 100° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket with a factory applied double pressure sensitive adhesive sealing system.

B. Insulation for concealed fittings and valves shall be glass fiber blanket with a K factor of .24 at 75° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket.

C. Exposed fittings, valves and flanges shall be insulated with molded fitting covers or fabricated segments of pipe insulation.

D. Insulation, jacket and sealant shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less per UL 723.

E. Insulation shall be Owens-Corning Fiberglass ASJ/SSL-II or approved equal.

F. All refrigerant piping (suction and liquid lines) shall be insulated with flexible foamed plastic, minimum 5.0 lb. Per cubic foot density, thermal conductivity not greater the 0.28 Btu-in/sq ft/°F/hour at mean temperature difference of 75°F.

G. All outdoor exposed refrigerant piping shall be painted with two coats of WB Armaflex finish. Prior to applying the finish, the insulation shall be wiped clean with denatured alcohol. The finish shall not be tinted. All seams shall be located on the lower half of the pipe.

H. Insulation thickness shall be as follows:

SYSTEM	PIPE SIZE	THICKNESS
Heating/Cooling Water	½"-1½"	1"
Heating/Cooling Water	2"-4"	1½"
Heating/Cooling Water	> 4"	2"
Make-up Water	all	1"
Refrigerant	all	1½"

2.9 HYDRONIC PIPING

A. Hot water system piping shall be as follows:

	2” and SMALLER	2½" and LARGER
Construction	Solder joint construction with screwed or flanged connections to valves and equipment as required.	Grooved end connection with flanged connections to equipment as required.
Pipe	Type "L" hard temper copper tubing	Carbon steel, Schedule 40 to 8"; ASTM A-120 up to and including 4" ASTM A-53 grade A B for pipe 5" and larger.
Fittings	Cast bronze or cast or wrought copper	Carbon Steel schedule to match pipe.

	fittings with 95-5 solder.	
Couplings	Same as fittings	Same as fittings.
Unions	Same as fittings	

2.10 VALVES

A. All valves shall be first quality of an approved manufacturer, shall be installed with the proper clearances and shall be tight at the specified pressures.

1. Valves shall be of minimum working pressure and materials as fittings specified for the service, however, in no case shall valves be designed for less than 125 PSI working pressure.
2. Where a specific manufacturer, brand and/or figure number is specified, an equivalent figure from an approved manufacturer shall be acceptable.
3. For shut off service the Contractor shall have the option of using gate valves, butterfly valves or ball valves with full open ID.
4. For throttling or modulating service the Contractor shall use a butterfly valve or another type of valve if a specific valve is specified on the drawings.

B. Butterfly Valves

1. Butterfly valves shall be of the flangeless type and may be lug or wafer style if not specified on the drawings.
2. Butterfly valves shall be rated 200 PSI bi-directional, differential pressure with a 200 PSI dead end service rating.
3. Butterfly valves shall have bodies of shock resistant ductile iron and shall have extended necks for 2" of insulation.
4. Butterfly valves shall have no exposed fasteners in the waterway to pin the disc to the stem.
5. Liners shall be molded in and supported by the valve body at the flange seals.
6. Top and bottom stem bushings of dissimilar material are required with a positive retention mechanism
7. Butterfly valves shall be NIBCO figure W/LD 2000.
8. Butterfly valves larger than 4" shall be provided with gear operators.

C. Check Valves

1. Check valves shall be bronze 2." and smaller; Cast iron or cast steel with bronze trim for 3" and larger.
2. All check valves shall have removable caps and regrindable disc and seat ring.
3. Bronze check valves shall be rated 125 PSI SWP, 200 PSI WOG as NIBCO figure T-413 or S-413.
4. Iron Check valves shall be 125 PSI SWP, 200 PSI WOG as NIBCO figure F-918.

D. Globe Valves

1. Globe valves shall be bronze 2½" and smaller; Iron with iron trim for 3" and larger as NIBCO figure T-211 or S-211.
2. Bronze globe valves shall be rated 125 PSI SWP, 200 PSI WOG

3. Iron globe valves shall be OS&Y 125 PSI SWP, 200 PSI WOG as NIBCO figure F-718-N.
4. All globe valves shall be suitable for repacking under pressure.

E. Ball Valves.

1. Ball valves shall be bronze 2½" and smaller as Pittsburgh Brass Manufacturing (PBM) Code B and shall be rated for 200 PSI @ 250^{O}F.
2. Ball valves shall be provided with self draining balls to drain to downstream side.

F.Gate

G. Valve Handles and Operators.

1. Butterfly valves shall be provided with locking lever type hand operators notched to allow incremental positioning and with a positional lock to function as a memory stop. The lock shall be lockable via a padlock.
2. Gate valves shall be provided with handwheels.

H. VALVE TAGS

1. Valve Tags shall be a minimum of 2" in diameter, constructed of No. 18 gauge aluminum with stamped numbers and letters filled in with black paint, fastened to valve by heavy aluminum or brass hooks or chain and shall be a different pattern than those used by plumbing and fire protection

2.11 STRAINERS

A. Strainers shall be installed at the inlet connections to each pump, make-up water connection, water regulating valve and vent, to protect the functionality of all automatic apparatus.

1. Strainers shall be Mueller or approved equal.

B. Strainers shall be line size, Y-pattern and set in the horizontal or vertical downward orientation.

1. Strainers shall be bronze rated 225 PSI at 150.F, 2½" smaller. Bronze strainers shall be Mueller model 351.
2. Cast iron rated ANSI 125# for 3" and larger. Cast iron strainers shall be Mueller model 751.

C. Provide valved dirt blow off connections for each strainer with a valve located 6" to 1'-0" below strainer. Nipples and valves for dirt blow off connections to be full size of strainer blow off tapping. Valves shall have hose bibb connections angled down and shall be provided with a chained cap.

2.12 PIPE EXPANSION COMPENSATION DEVICES

A. Piping shall be installed with expansion loops, expansion couplings, offsets or elbows to accommodate expansion and/or contraction. Where such accommodations are not possible

or at the Contractor's option an expansion compensation device may be used.

2.13 SLEEVES

A. Provide Schedule 40 galvanized steel pipe sleeves for each pipe passing through a wall, floor, partition or roof.

2.14 PRESSURE GAUGES

A. Pressure gauges shall be 4½" diameter dial, stainless steel case and ring phosphor bronze bourdon type, 1 percent full scale accuracy with bottom connection. Each gauge shall be provided with an isolation cock and pulsation snubber.

1. Gauges at pump inlets and outlets shall have a red setpoint indicator.
2. Gauge ranges shall be 0-100 PSIG or 10-50 PSIG as appropriate for the system and location.

2.15 THERMOMETERS

A. Thermometers shall be industrial type with 9 inch scale, red perma-colored liquid, black scale divisions on white background, union hub, separable brass well and adjustable swivel base. Extension wells shall be provided on insulated lines.

1. Thermometer ranges shall be 50-250°F for the heating water system and 0-100ºF for the cooling water system.

2.16 FLEXIBLE CONNECTORS

A. Flexible connectors shall be as manufactured by Mason Industries Model MFTNC twin sphere neoprene connectors.

2.17 RELIEF VALVES

A. Relief valves shall be constructed with iron bodies and all bronze working parts. They shall be set for the pressures indicated on the drawings or as required by the system and built to comply with the requirements of ASME.

2.18 AUTOMATIC AIR ELIMINATION ASSEMBLY

A. The air separator shall be a tangential inlet and outlet type separator. The air shall be vented to atmosphere via an automatic float activated vent valve located in the top of the air separator. The air elimination system shall be constructed of cast iron or welded steel; constructed and tested in accordance with Section VIII of the ASME code for a working pressure of 150 psi.

1. Vent valves shall be piped with a 3/8” copper tubing to the nearest floor drain.

2.19 PURGE/BALANCE VALVES

A. Purge valves shall be all bronze construction with a ½" drain tapping. Purge valves shall be installed as shown on the drawings and as required to completely purge all branches of the piping systems.

2.20 DUCT INSULATION MATERIALS - DUCT WRAP

A. Insulation for ducts and fittings shall be glass fiber with a K factor of .25 at 75° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket with a 2" stapling flange.

1. Insulation, jacket and sealant shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less per UL 723.
2. Insulation shall be Owens-Corning Fiberglass Type 150 or approved equal.

2.21 WEATHERPROOFING OF OUTDOOR INSULATION MATERIALS

A. Finish outdoor attic insulated piping with .016" thick aluminum jacket with Benjamin Foster 30-45 Foam Seal.

B. Finish fittings and valves with mitered sections of the insulation with factory attached aluminum jackets.

2.22 FILTERS

A. Unless otherwise noted filters in fan VAV and HRVs shall be 2” 30-30 filters.

B. See RTU Filters.

2.23 RECTANGULAR DUCTS AND FITTING

A. All ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.
B. All ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

2.24 ROUND DUCTS

A. All ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

2.25 FLEXIBLE DUCTS AND CONNECTORS

A. All flexible ducts shall be made from aluminum sheet, spiral wound into a corrugated tube. No adhesives shall be used in it's construction. Spiral wound flexible ducts will not be acceptable.

B. All flexible ducts must conform to NFPA 90A requirements and be tested in accordance with UL-181 and bear a UL label and be installed in accordance with their listing by UL.

C. All connections between vibrating or rotating equipment and ductwork shall be made with a flexible connection consisting of a heavy fiber glass fabric, double coated with neoprene and shall be fireproof conforming to NFPA 90A, waterproof and airtight. The flexible connection shall be a minimum of 6" long and held in place with heavy metal bands.

2.26 VOLUME DAMPERS

A. Furnish and install, where indicated on the drawings or where required for balancing, air splitter dampers, butterfly dampers, or opposed blade dampers with indicating and locking quadrants or push rods and pillow blocks.

B. Opposed blade dampers shall be manually operated multi-blade type with sleeve bearings, galvanized steel interlocking blades and a galvanized steel frame. In ducts over 19" in depth and 12" in height, use multiple opposed blade type, gang operated dampers with a maximum blade width of 8". Fabricate the damper blades of 10 gauge steel with hemmed edges, and a maximum length of 48". Damper operating rods shall be the full blade length and shall extend through the duct to externally mounted bearing plates. On insulated ductwork, bearing plates shall be flush with insulation finish and fastened to the duct. The operating lever shall be of the indicating type with locking quadrant. Splitter dampers shall be sufficiently long to extend the full width of the branch duct to which they are attached. Where necessary they shall curve to scoop branch duct air out of the main duct airstream. The dampers shall be constructed in accordance with the latest SMACNA standards and shall be at least two gauges heavier than the ducts in which they are installed.

2.27 ACCESS PANELS

A. Hinged access panels shall be provided at locations of volume dampers, and elsewhere as required to service the duct systems. Access doors shall be fully gasketed for air tight seal at the rated working pressures of the systems in which they are installed. Access doors shall be adequately sized for their intended purpose and equipped with a minimum of two sash locks. Access doors in insulated ducts shall be double wall and insulated.

2.28 REGISTERS, GRILLES AND DIFFUSERS

A. The types, sizes and airflow patterns of the registers, grilles and diffusers as specified and as shown on the plans have been selected to accomplish the intent and purpose of the system. Any substitutions proposed for items scheduled, shown or specified must provide the same air flow patterns, at the same air volumes and must have the same acoustical characteristics as the specified elements.

B. All interiors of all ducts in back of all registers, grilles and diffusers shall be painted with one coat of flat black nonflammable paint.

C. Duct connections to supply devices shall be made inside the collars, if any, and, duct connections to return or exhaust devices shall be made outside the collars, if any.

D. All registers, grilles and diffusers shall have a baked enamel, white, semi-gloss finish.

E. Square and rectangular diffusers shall have removable cores with opposed blade dampers, gasketed borders and concealed fastenings.

F. Frame types of diffusers shall be as appropriate for the type of ceiling in which they are to be installed.

G. Supply, return and exhaust air registers shall have opposed blade dampers and gasketed borders.

2.29 THERMOSTATS

A. Thermostats shall be provided where shown on the drawing.

2.30 INLINE PUMPS

A. Furnish and install pumps with capacities as shown on plans.

B. The pumps shall be of the horizontal, oil-lubricated type, suitable for 125 pounds working pressure

C. The pumps shall have a ground and polished steel shaft with a hardened integral thrust collar. The shaft shall be supported by two horizontal sleeve bearings designed to circulate oil.

D. The pumps are to be equipped with a mechanical seal with carbon seal face rotating against a ceramic seat. The motor shall be non-overloading at any point on pump curve.

E. The motor shall be of the drip-proof, sleeve-bearing, quiet-operating, rubber mounted construction. Motors shall have built-in thermal overload protectors.

2.31 FIRE STOPPING

A. Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and fired experience.

B. Provide all required accessories including, but are not limited to: Slag-/rock-wool-fire insulation, Fire-rated form board, Temporary forming materials, Substrate primers, Collars and Steel sleeves

2.32 SHEET METAL WORK

A. All supply, return and exhaust air ductwork of all types shall be constructed of galvanized sheet metal based on the "Pressure Class" indicated in the "Minimum SMACNA

Construction Standards" table found hereinafter. Note: In addition, the construction pressure class shall be at least 2" more (negative or positive) than the scheduled fan pressure.

B. In addition to sheet metal ductwork provided under this Contract, furnish and/or install accessories and devices furnished by others, including but not limited to smoke detectors. Provide and install miscellaneous sheet metal work including safing, mixing baffles, and blank off panels at unused louver areas.

C. All duct systems specified to be installed under this Contract, shall conform to the drawings, specifications, Standards, details and recommendations of the latest Edition of SMACNA "HVAC Duct Construction Standards - Metal and Flexible"; and "Round and Industrial Duct Construction Standards" (hereinafter referred to as Duct Manual).

D. Provide volume dampers in all branch takeoffs and in all main branches and ducts of all ductwork systems (supply, return and exhaust) for properly regulating and balancing airflow to all terminal outlets, for all duct sizes, whether shown on the drawings or not. Volume dampers installed in ductwork that is to be externally insulated shall have extended activator/handle rods such that adjustment of the damper handle will not disturb the insulation.

E. Fire Dampers shall be provided as shown on the drawings and wherever Architectural drawings indicate fire and rated partitions.. All dampers shall meet the requirements of NFPA 90A and further shall be tested, rated and labeled in accordance with UL 555, latest edition.

2.33 AIR TERMINAL BOXES (VAV)

Fan Powered Terminals (Constant Volume)

1. Furnish and install TITUS Model DTQP series flow fan powered terminals of the sizes and capacities shown on the plans. Space limitations shall be reviewed carefully to ensure that all terminals will fit the available space.
2. Terminals should be certified under the ARI Standard 880 Certification Program and carry the ARI Seal. Non-certified terminals may be submitted after testing at an independent testing laboratory under conditions selected by the engineer in full compliance with ARI Standard 880. These tests must be witnessed by the engineering consultant with all costs to be borne by the terminal manufacturer. Testing does not ensure acceptance.
3. The terminal shall be designed, built, and tested as a single unit including motor and fan assembly, primary air damper assembly,water heating coils, and accessories as shipped. Unit shall ship as a complete assembly requiring no field assembly (including accessories). All electrical components shall be UL listed and installed in accordance with the UL Standard 1995. Electrical connection shall be single point. All electrical components, including low voltage controls, shall be mounted in sheet metal control enclosures. The entire terminal shall be ETL listed as a complete assembly.
4. The terminal casing shall be minimum 20-gauge galvanized steel, internally lined with engineered polymer foam insulation, which complies to UL181 and NFPA 90A. Insulation shall be 1½ pound density, closed cell foam. Exposed fiberglass is not acceptable. The insulation shall be mechanically fastened to the unit casing. The casing shall be designed for hanging by sheet metal brackets.
5. The terminal casing shall have top and bottom access panels, which allows removal of fan assembly and servicing of terminal without disturbing duct connections.
6. ECM Motor

a. Fan motor assembly shall be forward curved centrifugal fan with a direct drive motor. Motors shall be General Electric ECM variable-speed dc brushless motors specifically designed for use with single phase, 277 volt, 60 hertz electrical input. Motor shall be complete and operated by a single phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commutate the stator. All motors shall be designed for synchronous rotation. Rotor shall be permanent magnet type with near zero rotor losses. Motor shall have built-in soft start and soft speed change ramps. Motor shall be able to be mounted with shaft in horizontal or vertical orientation. Motor shall be permanently lubricated with ball bearings. Motor shall be directly coupled to the blower. Motor shall maintain a minimum of 70 percent efficiency over its entire operating range. Provide a motor that is designed to overcome reverse rotation and not affect life expectancy.
b. The terminal unit manufacturer shall provide a factory installed PWM controller for either manual or DDC controlled fan cfm adjustment. The manual PWM controller shall be field adjustable with a standard screwdriver. The remote PWM controller shall be capable of receiving a 0-10 Vdc signal from the DDC controller (provided by the controls contractor) to control the fan cfm. When the manual PWM controller is used, the factory shall preset the fan cfms as shown on the schedule.
c. The primary air damper assembly shall be heavy gauge steel with shaft rotating in Delrin self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking, and a synthetic seal to limit close-off leakage to the maximum values shown in the following table Provide an AeroCross™ four point, center-averaging differential pressure airflow sensor. A sensor that delivers the differential pressure signal from one end of the sensor is not acceptable. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.
d. The sound levels shall not exceed the octave band sound power levels indicated in the table above. Sound performance shall be ARI certified. If NC is provided instead of octave band sound power data, the radiated and discharge path attenuation function for the specified NC shall be based upon factors found in ARI Standard 885-98, Appendix E. No additional attenuation factors shall be deducted from the sound power.

7. Hot Water Heating Coils
   a. Hot water heating coils shall be enclosed in a minimum 20-gauge galvanized steel casing, with flanged construction for attachment to metal ductwork. Coils shall be factory installed on the terminal. Fins shall be rippled and corrugated heavy gauge aluminum, mechanically bonded to tubes. Tubes shall be copper with minimum wall thickness of 0.016 inch, with male solder header connections. Coils shall be leak tested to 300 psi, with minimum burst pressure of 1800 psi at ambient temperature. Number of coil rows and circuits shall be selected to provide performance as required per the plans. Coil performance data shall be based on tests run in accordance with ARI Standard 410.

A. ESV Basic Unit

1. Furnish and install TITUS Model DESV single duct, variable air volume terminals of the sizes and capacities shown in the plans.

2. Terminals shall be certified under the ARI Standard 880 Certification Program and carry the ARI Seal. Noncertified terminals may be submitted after testing at an independent testing laboratory under conditions selected by the engineering consultant in full compliance with ARI Standard 880. These tests must be witnessed by the engineering consultant with all costs to be borne by the terminal manufacturer. Testing does not ensure acceptance.
3. The terminal casing shall be minimum 22-gauge galvanized steel, internally lined with engineered polymer foam insulation which complies to UL181 and NFPA 90A. Insulation shall be 1½ pound density, closed cell foam. Exposed fiberglass is not acceptable. The insulation shall be mechanically fastened to the unit casing. The casing shall be constructed to hold leakage to the maximum values shown in the Casing Leakage table.
4. The damper shall be heavy gauge steel with shaft rotating in Delrin® self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking and a synthetic seal to limit close-off leakage to the maximum values shown in the Damper Leakage table.
5. Actuators shall be capable of supplying at least 35-inch lbs. of torque to the damper shaft and shall be mounted externally for service access. Terminals with internal actuator mounting or linkage connection must include gasketed access panel, removable without disturbing ductwork. Casing with access panel shall be constructed to hold leakage to the maximum values shown in the Casing Leakage table.
6. At an inlet velocity of 2000 fpm, the minumum static pressure required to operate any terminal size shall not exceed 0.13-inch wg for the basic terminal.
7. Sound ratings for the terminal shall not exceed 30 NC at 1.0” static pressure. Sound performance shall be ARI certified.

2.34 WATER PUMPS

A. Pumps shall be in line, centrifugal type as indicated with flexible coupling connections of pump to motor, and coupling guard as manufactured by Bell and Gossett, Taco or Thrush. Pumps shall be complete with mechanical seals, standard bronze fittings, and 1750 RMP motors, magnetic starters with "Hand-Off-Auto" selector switches and pilot lights in covers. Pump capacities shall be as indicated on the drawings. All pumps shall be nonoverloading at any point on pump curve.

2.35 FLEXIBLE CONNECTORS

A. Neoprene Flexible Connectors:

1. Furnish and install where indicated on the drawings and at the piping connections to all pumps, chillers, and any other equipment that vibrates, flexible connectors. They shall be constructed of nylon reinforced neoprene with 150 lb flanges. Units shall be rated at 215 psi operating pressure at 240°F.
2. The units shall have a minimum axial compression of 2", transverse movement of 1 1/2", and angular movement of 30°.
3. Connectors shall be Model TF as manufactured by C-Flex or equal equipment by Mason Industries or Armstrong Pump Company.

2.36 UNIT HEATERS

A. Propeller type, arranged for horizontal discharge, complete with suitable efficient air deflectors, hot water coil, direct driven motor and guard. Unit shall be manufactured by Airtherm, Sterling or Modine with capacities and sizes as indicated on the drawings. Unit heaters shall be provided with disconnect switches, mounted on heater casing.

B. Cabinet, centrifugal, multiple type, with arrangements as indicated on the drawings, complete with direct driven motor with intergral overload protection, nonferrous hot water heating coils, and cabinets with colors as selected by Architect. Units shall be as manufactured by Airtherm, Modine or Sterling.

2.37 WATER TREATMENT

A. The HVAC Contractor shall furnish and install where shown on the drawings and where specified hereinafter, the necessary apparatus to provide water treatment and service as furnished by Betz Laboratories, Inc., Barnstead Still and Sterilizer Company, Barclay Chemical, Inc., or as approved.

B. A contract satisfactory in form and substance to the Owner shall be executed between the HVAC Contractor and the Water Treatment Company to furnish supervisory service to assure the use of the proper chemical treatment to and for the systems of a period of one year from the date of the initial treatment thereof.

C. The contract shall be assigned by the HVAC Subcontractor to the Owner on the date that the building is accepted by the Owner so that water treatment will continue uninterrupted during the one year life of the contract. The water treatment company shall perform the following through its agents:
   1. Supervise the initial introduction of water treatment.
   2. Provide service calls by its agents at a frequency of not less than once per thirty (30) days thereafter.
   3. Furnish all required chemicals for proper treatment of all systems hereinafter described together with all necessary testing equipment and reagents for field analysis of the water during the aforementioned one year period.

D. HVAC Subcontractor shall assume responsibility for the field testing and control, regular addition of chemical treatment in whatever amounts are necessary on each of the systems hereinafter described until the date of acceptance of the building by the Owner.

E. Before actual execution of the above contract, a copy of the proposed contract form shall be submitted to the Architect for approval.

F. Hot Water Systems:

   1. Liquid chemical bypass type feeders of approximately 5-gallon capacity, complete with valves and fittings shall be connected across the water pumps.
   2. The water circuits shall be treated with sufficient amounts of the proper chemicals to give a starting concentration of 1,000 ppm of sodium chromate, the concentration not to fall below 550 ppm during operation of any of these systems.

2.38 ERV UNIT

A. Casings: Panels shall be of 18 gauge steel, cleaned, phosphatized and finished inside and out with baked enamel finish. Unit shall be completely insulated with 1" fireproof, permanent, odorless glass fiber material with knockouts provided on both sides of unit for utility and

piping connections.

B. Fans shall be double width, double inlet, forward curved, multi-blade fans, statically and dynamically balanced with fan assemblies rotatable from top to rear. Variable pitch drive shall be provided.

C. Casings and all accessories, with the exception of coils, shall be given a protective enamel paint finish. Fans and scroll shall be coated with corrosion resistant paint.

D. Unit shall be complete with gas-fired furnace,. Automatic outside air damper and filters .

E. ERV shall be complete with remote control unit.

F. Unit shall be provided with variable drive sized with 50% safety over motor nameplate and shall be complete with magnetic starter with "H-O-A" in cover.

2.39 MOTORS

A. All motors shall be premium efficiency type.

B. Motors 1 HP and greater shall be 208/230 Volt/3 Phase/60 Hertz.

C. All motors shall be rated for inverter duty, and stamped as such.

D. All motors shall have Class F insulation or higher temperatures

E. Motors shall be manufactured by Toshiba, General Electric Co., Baldor or Approved Equal.

2.40 ROOF EXHAUST FAN

A. Furnish and install fans with capacities as shown on plans.

B. Roof exhaust fans shall be centrifugal type as scheduled.

C. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances.

D. Wheels shall be statically and dynamically balanced.

E. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. Windbands shall have a rolled bead for added strength and shall be joined to curbcaps with a leakproof, continuously welded seam.

F.Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted on vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.

G. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed. Drives shall be sized

for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.

H. Motor pulleys shall be adjustable for final system balancing. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring.

2.41 HYDRONIC PUMPS AND ACCESSORIES

A. Acceptable manufactures: Bell and Gossett. Taco, Armstrong or approved equal.

B. Construction shall permit complete servicing without breaking pipe or motor connections.

C. Pumps to operate at 1750 rpm unless scheduled or specified otherwise.

D. Provide guards around shafts and couplings in accordance with OSHA and ANSI recommendations.

E. All parts shall be suitable for Variable frequency drives; including but not limited to Motor, Pump, all pump components, coupling, and base.

F. Design and performance requirements: Pump curve shall rise continuously from maximum flow to cut off. Shut-off head shall be approximately 20 percent greater than design head, unless Pump brake horsepower not to exceed motor horsepower rating over entire operating range (from shut-off to run-out). Motor shall not operate in service factor. Pumps shall operate within the preferred operation region as defined by the Hydraulics Institute. Select pump for operation at or near peak efficiency. Cavitation-free at all points on curve. Impeller diameter shall not exceed 90 percent of the maximum cutwater diameter. Vibration levels of pump shall be within the vibration limits established by hydraulic institute.

2.42 EXPANSION AND COMPRESSIONS TANKS

A. Tanks shall be the pressurized captive air bladder type, with replaceable elastomeric bladder suitable for a maximum operating temperature of 240°F.

B. Tanks shall be constructed and certified to ASME Section VIII - Pressure rating of 150 psig, Temperature of 240°F

C. Provided with integral steel base ring for vertical mounting, charging valve enclosure, remote air connector coupling, system connection and lifting rings.

D. Tanks shall be provided with factory applied rustproof coat of paint to the exterior of tanks.

E. AIR SEPARATORS - Provide tangential type air separator with flanged inlet and outlet connections and bottom blow down drain connection with valve.

2.43 CHEMICAL WATER TREATMENT

A. The HVAC Contractor shall engage the services of a nationally recognized water treatment manufacturer or local representative of such manufacturer to provide a complete water treatment service, designed to minimize corrosion and scale formation in all water systems. This service shall include providing the equipment, controls, chemical feed pumps, bypass feeders, all chemicals and consulting analysis service for the initial clean out and start-up period of each system.

2.44 TESTING, ADJUSTING, & BALANCING

A. The HVAC Contractor shall procure the services of an independent Balancing and Testing Contractor who specializes in the balancing and testing of heating, ventilating and air conditioning systems to balance and adjust, all moving equipment and air distribution and exhaust systems and test all water systems and equipment, as herein specified. All work by the Balancing Contractor shall be done under direct supervision of a qualified heating and ventilating Engineer employed by the Balancing Contractor.

2.45 ROOFTOP AIR HANDLING UNITS

A. General

1. Rooftop air handling units shall be as manufactured by York manufacturer Inc.V-Series
2. Units shall be manufactured by York or equal in an ISO 9001 certified facility. YORK's Millennium package units are convertible single packages with a common footprint cabinet and common roof curb for all 25 through 40 ton models. All units have independent refrigeration circuits and provide up to 4 stages of cooling. These packaged cooling/heating air conditioners are designed for outdoor installation and can be easily installed on a roof curb or slab. All Millennium units are self-contained and assembled on rigid full perimeter base rails with internal lifting lugs for overhead rigging. Every unit is completely charged, wired, piped, and tested at the factory to provide quick and easy field installation. Only utility and duct connections are required at the point of installation. The multi-stage gas fired heaters have aluminized steel tubular heat exchangers and spark to pilot ignition. They are available in natural gas with field conversion to propane.
3. Description: Supply Based on York Millennium packaged rooftop system in accordance with the capacities in the plans. Units shall be rated by the manufacturer at a minimum 10.5 EER according to ARI 360. Units shall be shipped in a single package, fully charged with R-410A refrigerant. The manufacturing facility shall be registered under ISO 9001 Quality Standards for Manufacturing. Units shall carry both ETL and CGA safety approval ratings. Tags and decals to aid in the service or indicate caution areas shall be provided. Installation and maintenance manuals shall be supplied with each unit. Units shall be capable of providing mechanical cooling down to 40°F (0°F with low ambient kit). Unit shall be capable of starting and running at 120°F. Unit electric and gas connections shall be either through the curb or the side of the unit.
4. Construction; The base rail shall be constructed of 12 gauge galvanized steel, extending the full perimeter of the unit. All components shall be supported from the base, and the base shall include integral lifting lugs. The unit base rail shall overhang the roof curb for water runoff and shall have a fabricated recess with a continuous

flat surface to seat on the roof curb gasket, providing a positive, weather tight seal between the unit and the curb.

5. Casing; The unit cabinet shall be double wall construction to provide both maximum resistance to bacterial growth in the air stream and superior structural integrity. All sheet metal shall be G90 mill galvanized sheet metal, formed and reinforced to provide a rigid assembly. Sheet metal shall be cleaned in an alkaline and zinc phosphate bath, and the exterior surfaces shall be coated with a 1.5 mil powder paint, capable of withstanding 1000 salt spray hours in accordance with ASTM B-117. The unit shall be insulated with 1-1/2", 1 pound fiberglass insulation between the two sheet metal skins. Insulation shall meet NFPA-90A regulations for smoke and flame spread ratings. The cabinet corner post and the intermediate side supports shall be 16 gauge steel. All access doors shall be 18 gauge on the exterior surfaces, and 20 gauge on the interior. Floor shall be 18 gauge, and 24 gauge. All serviceable sections shall have optional hinged access doors with latches on both sides of the unit. All access doors shall be constructed of 20 gauge steel on the outside, with 24 gauge on the inside. Each door shall seal against a rubber gasket to prevent air and water leakage. The roof shall be double wall, with 18 gauge on the external surface and 24 gauge on the interior. The roof shall be formed with a 45 degree drip lip overhanging the sidewalls to prevent precipitation drainage from streaming down the side of the unit. Roof sections shall be connected together via integral channels fastened with screws and sealed with rubber gasketing. Each fastened seam shall be further protected by a sheet metal channel covering the full length of the gasket surface, making a completely water tight seal.
6. Unit shall have the approval of one of the following agencies: Underwriters' Laboratories (UL), Electrical Testing Laboratories (ETL) or American Standards Association (ASA). The air handler shall bear an appropriate label certifying that the unit has been designed and manufactured in strict accordance with the UL1995 Standard for air handling equipment. If the manufacturer cannot provide an ETL/UL sticker on the air handler, it will be the sole responsibility of the contractor to arrange for local ETL or UL approval and labeling.
7. The Unit Electrical Panel(s) shall be built in strict accordance to NEC Standards and shall bear an appropriate label certifying compliance with UL Standard 508A.
8. The air handling equipment manufacturer shall provide single source responsibility for all components for the unit whether specifically manufactured by the unit manufacturer or obtained outside and installed in the equipment with the exception of consumable items such as filters, fan belts, etc., or as specifically warranted by the product manufacturer such as motors, VFD's, etc.
9. The attached schedules, tables and specifications are to be used as the selection criteria for the air handling equipment to include Air Flow Rates, External Static Pressures and Water Flow Rates. The following are to be equaled or bettered: Coil Face velocities and Filter Face Velocities. The following are to be met within 5% of specified values: internal air pressure drops, water pressure drops.
10. Additional Testing and Quality Assurance as explained in individual component / item sections in the following paragraphs of this specification.
11. Warranty:
    a. Unit manufacturer to warrant it's product to be free of defects in materials and workmanship under normal use when installed and operated in accordance with factory recommendations for a period of 18 months from date of shipment or 12 months after initial equipment start-up, which ever occurs first. Equipment found to be defective should be replaced or repaired to include all parts and labor. Component parts that require periodic replacement due to normal wear such as filters, fan belts, etc. are not covered by the warranty.

B. Submittals:

1. Submit shop drawings with product data.
2. Shop drawings shall indicate assembly weights, unit dimensions, required clearances, construction details, and field connection details.
3. Product data shall indicate dimensions, weights, capacities, ratings, fan performance to include fan curves, motor electrical characteristics to include motor technical data sheets, coil capacities to include performance printouts with pressure drops (water & air), vibration isolation, filter data sheets to include pressure drops, gauges and finishes.
4. Clearly identify any variations from contract documents.
5. Provide space on cover document for contractor and architect/engineer review stamps.
6. Revise & resubmit submittals as required.
7. Submit installation, start-up and Operation & Maintenance Data.
8. Include instructions for rigging, lifting, bearing lubrication, filter replacement, motor and drive replacement, and wiring diagram.
    a. Include a recommended spare parts list customized to each unit complete with appropriate tag #, serial and / or part numbers along with a description to clearly identify the items.

C. SUPPLY AIR FAN
1. Fans shall be centrifugal type, statically and dynamically balanced in the factory. Fan wheels shall be designed for continuous operation at the maximum rate of fan speed and motor HP. The fan and motor assembly shall be mounted on a common base to allow consistent belt tension with no relative motion between the fan and motor shafts. The entire assembly shall be isolated from the unit base with rubber isolators or optional 1" or 2" deflection springs. The fan discharge shall be connected to the cabinet through a reinforced neoprene flexible connection to eliminate vibration transmission from the fan to the unit casing. Fans shall be double-width, double-inlet with forward curved blades. Fan wheels shall be of Class I or Class II construction.

D. OPTIONAL
1. On variable air volume units without variable frequency drives, fans shall be provided with heavy gauge, corrosion resistant blades, with zinc-plated steel inter-locking operating mechanism. Both inlet vanes must operate from a single shaft and be synchronized for precise control.Units equipped with variable frequency drive on supply fan must be controlled by a duct static transducer providing a 2-10 VDC signal to the drive. Supply fan variable frequency drives shall have factory option of being equipped with a manual drive bypass.

E. BEARINGS AND DRIVES
1. Bearings shall be self-aligning pillow-block re-greasable ball bearings with an average life expectancy of 200,000 hours. Grease fittings shall be accessible through access doors. Fan motors shall be NEMA designed, Standard efficiency (option, Hi-efficiency) ball bearing type with electrical characteristics and horsepower as specified. Motors shall be 1750 RPM, open drip proof type. The motor shall be located within the unit on an adjustable, heavy steel base. All fan motor drives shall be selected for a minimum service factor of 1.2 and have fixed pitched sheaves.

F. AIR FILTERING SYSTEM
1. All filter holding frames shall be of heavy duty construction designed for industrial applications. All filters shall be either side accessible or front loading with access doors provided on both sides of the filter section. All filter media shall be Class II listed

under UL Standard 900. Filter efficiencies shall be rated in accordance with ASHRAE Standard 52-76 2" Throwaway Filters with fiberglass media multiple shall be standard

2. Two inch pleated, throwaway filters with 30% efficiency. Rigid filters shall be high performance, expanded area, disposable type filters. Rigid filter sections shall be preceded by a 2" throwaway prefilter assembly. Filter efficiency shall be 95% (Option: 65%) based on ASHRAE Standard 52-76.

G. AIR INLET SYSTEM

1. Outside Air inlet openings shall be covered by a factory installed rain hood permanently attached to the cabinet to prevent windblown precipitation from entering the unit. The rain hoods on the front and back of the unit shall be rotated into the cabinet and secured for shipment so that upon installation they need only be rotated upwards and screwed into place. The outside air hood shall contain a removable and cleanable filter with an efficiency rating of 50% based on ASHRAE 52- 76. All damper assemblies shall be of low leak design. Damper blades shall be fabricated from a minimum of 16 gauge galvanized steel. Blade ends and edges shall be covered with vinyl seals. Damper shafts shall be fabricated from solid steel and mounted in the frame with bronze bearings. On all units not equipped with an economizer, an option shall be available for a manually adjustable outside air damper shall be capable of admitting 0-25% outside air.
2. An economizer shall have outdoor air and return air dampers that are interlocked and positioned by fully modulating, solid state damper actuators. The actuators shall be spring loaded so that the outside air damper will close when power to the unit is interrupted. The operation of the economizer shall be fully integrated into the cooling control system. The economizer shall be available for control via a dry bulb sensor (Optional: single or dual enthalpy sensors).
3. Building air exhaust shall be accomplished through barometric relief dampers installed in the return air plenum. The dampers will open relative to the building pressure. The opening pressure shall be adjustable.

H. Exhaust Air Fans

1. General - forward curved centrifugal fan(s) shall be installed in the return air plenum for positive power exhaust. Fans shall be on a common shaft, driven by a single motor. The fans, motors and drives shall be of the same quality and design as specified for the Supply Air Fan, except the fans shall be Class I. Fans shall be capable of exhausting up to 100% of the nominal CFM of the unit. Non-modulating Exhaust - Units with non-modulating power exhaust shall have a barometric relief damper to prevent outside air from entering in the off cycle. The fans shall cycle on and off with building pressure. Modulating Operation - The fans shall be capable of modulating the amount of air from 0% to 100% of nominal CFM. Modulation shall be through discharge dampers or variable frequency motor speed modulation. Dampers or VFD shall be controlled by static pressure in the conditioned space or return air duct.

I. HEATING SYSTEM

1. Gas-fired Heating Section One or more gas-fired heating modules shall be installed to provide the heating requirements per the schedule shown on the plans. The heat exchanger shall be of tubular design. Tubes shall be 2 ¼" OD and constructed of minimum 20 gauge, G160 aluminized steel (1.6 mil aluminum silicone alloy) for corrosion resistance (Optional: 409 Stainless Steel). Flue baffles shall be made of 430 stainless steel. Each gas-fired heat module shall have an induced draft combustion fan

with energy efficient intermittent pilot spark ignition and redundant main gas valves with pressure regulator. Units with standing spark ignition shall not be acceptable. An induced draft fan shall be provided to maintain a positive flow of air through each tube, to expel the flue gas and to maintain a negative pressure within the heat exchanger relative to the conditioned space. Induced draft fans shall be direct-drive. One (1) high limit controller per heating module, with automatic reset to prevent the heat exchanger from operating at an excessive temperature will be installed. A centrifugal switch on the induced draft fan motor shaft must be provided to prevent ignition until sufficient air flow is established through the heat exchanger. Secondary airflow safety shall be provided by rollout switch protection. The rollout switch shall discontinue furnace operation if the flue becomes restricted. Units shall ship with an external flue to be shipped in the unit and mounted on the job site. The flue shall discharge products of combustion above the unit, preventing recycling of corrosive combustion gases back through the heat exchanger. Gas heating sections shall be both ETL and CGA approved to both US and Canadian safety standards.

J. REFRIGERATION SYSTEM
   1. Units shall have four independent refrigerant circuits for maximum load-matching capability. Each refrigerant circuit shall be controlled with a balance-port thermal expansion valve for maximum control at low load conditions.
   2. Evaporator coils shall be direct expansion type with intertwined circuiting to assure complete coil face activity during part load operation. Coil tubes shall be 3/8” OD copper, internally enhanced tubes. Fins shall be enhanced aluminum mechanically expanded to bond with the copper tubes. Coil casing shall be fabricated from heavy gauge galvanized steel. All coils shall be pressure tested at a minimum of 450 PSIG. A coated steel or optional stainless steel drain pan shall be provided under the entire length and width of the evaporator coil, including all return bends. The main drain pan shall be sloped a total of ¼” per foot towards the drainage point. Main drain pan shall be easily cleanable in the field. The condensate drain opening shall be flush with the bottom of the drain pan to allow complete drainage. Coils in excess of 48” high shall have an intermediate drain pan, also fabricated of stainless steel extending the entire finned length of the coil to provide better water drainage. Drainage from the intermediate drain pan shall be to the primary drain pan. OPTIONAL: Evaporator coils shall be protected by the Technicoat 10-1 four coat process. Coils shall be dipped in a phenolic coating, which provides substantial resistance to corrosion of aluminum and copper.

K. Compressors
   1. Units shall have four industrial duty hermetic scroll compressors, independently piped and charged. Compressors shall have an enlarged liquid carrying capacity to withstand rugged operating conditions. Compressor frame shall be cast iron, with cast iron fixed and orbiting scrolls. Each compressor shall feature a solid state protection module, designed to protect the compressor from over temperature and overcurrent conditions. Each compressor shall include the following safety and convenience devices: replaceable suction screen, discharge line check valve, and oil sight glass. Compressors shall be vibration isolated from the unit, and installed in an easily accessible area of the unit.
   2. Condenser coils shall have 3/8” seamless copper tubes, arranged in staggered rows, mechanically expanded into aluminum fins. Coils shall be protected from hail damage with a V configuration, with individual flat coils rotated 30 from the vertical plane for each condensing circuit. Condensing coils shall have an integral subcooler for more

efficient, stable operation. OPTIONAL: Condenser coils shall be protected by the Technicoat 10-1 four coat process. Coils shall be dipped in a phenolic coating, which provides substantial resistance to corrosion of aluminum and copper.

3. Condenser fans shall be direct drive, propeller type, discharging vertically. Condenser fan motors shall be 3 phase, totally enclosed air over (TEAO) type, with built in thermal overload protection.

L. Refrigerant Piping

1. All interconnecting piping between refrigeration components shall be copper tubing with brazed joints. Each refrigerant circuit shall be equipped with liquid line filter drier, and moisture indicating sight glass. Each circuit shall also have both high and low pressure switches installed on either side of the compressor and include shrader depressors for replacement of the pressure switches without removing charge. All small diameter distributor tubing to the evaporator coil shall be protected by polyurethane sleeves over the length of the tubing to prevent the tubes from copper-to-copper contact during shipment or operation.

M. Hot Gas Bypass

1. Unit shall have hot gas bypass factory installed on the lead compressor.

2.46 CONTROLS

A. GENERAL DESCRIPTION

1. Equipment with Simplicity Elite™ as standard shall be factory run-tested through the control, after the test is complete; there will be no wires to re-connect. All control wiring points shall be tested and verified through communication. The control shall be UL or CSA recognized. The control shall be manufactured in a manufacturing facility that is certified to ISO 9001.

B. COMPRESSOR CONTROL

1. The control shall have a five-minute Anti-Short Cycle Delay to prevent excessive compressor cycling. The control shall have a three-minute minimum run time to insure that oil gets returned to the compressor each time it starts. The minimum runtime shall be programmable up to 10 minutes. The control shall monitor the High Pressure switch, the Low Pressure switch, and the Compressor Overloads separately for each refrigeration circuit. The control shall have a 30 second Low Pressure Switch bypass when it starts any compressor.
2. A hard compressor lockout shall occur if the control detects the same switch trip three times in a two-hour window, which starts when the first trip occurs. On the first and second trips, the control will turn the compressor off and wait five-minutes after the switch re-closes, before restarting the compressor.
3. The control shall be capable of operating both compressors and the economizer when there is a call for both stages of cooling. The control shall have a means of locking out mechanical compression below a programmable low ambient trip point. This must be done without adding extra components to the unit. The control shall have a means of locking out the mechanical compression when the economizer is operating in free cooling mode without additional components. The control shall have a means of starting the compressor before the indoor Fan comes on when operating with a Thermostat in the AUTO FAN mode.

C. FAN CONTROL

1. The control shall have fully adjustable Fan ON and Fan OFF delays for both Heating and Cooling settable at the control or via communication. The control's default Fan OFF delay for Cooling shall be 30 seconds to take advantage of the remaining capacity in the coil after the compressor has been turned off. The control shall lock on the Fan if the high temperature limit trips three times in one hour of operation. The control will have a software programmable Fan Mode Switch for Auto operation or Continuous operation. When the Fan is in the Continuous mode, it will run continuously during the occupied schedule and in the Auto mode when in an unoccupied schedule. The control shall be capable of operating the fan without a G or fan signal from the thermostat.

D. EQUIPMENT CONTROL FEATURES

1. The control shall be capable of communicating on the Standard Open protocol, Modbus® RTU. The register data for the Modbus® must be publicly available and open. Monitoring Software shall be provided at no cost. The monitoring software shall have a flashing icon when any unit wired to the computer has an alarm. Clicking the flashing icon shall display the fault code and the details of the fault. The networking setup shall be completed by connecting a three-wire daisy chain cable to each unit, then powering all the units up and pushing a button on each control. There shall not be any dipswitches to configure the network address.
2. The control shall use a communication driver that is capable of having 64 nodes on the bus before a repeater is needed. The control shall use non-volatile memory to store the last five alarms. There shall be a single button to push to recall these last five alarms. The alarms shall be stored first in last out. The first flash code shall be the last alarm that occurred. There shall be a button press sequence to clear the alarms in non-volatile memory. The control shall have a button to reset compressor lockouts without powering the unit down.
3. The control shall have a button to clear compressor Anti-Short Cycle Delays. When this button is pressed it will only clear the Anti-Short Cycle Delays for one cycle only and not permanently. The control will be compatible with any BAS (Building Automation System). Any BAS shall be able to control the equipment when wired to the control's Thermostat Terminal Strip. The control shall have loading of at least 25 milliamps on all thermostat inputs for controllers and thermostats that use output TRIACs.
4. The control shall have a Smoke Detector Shutdown input on the board. The control shall be powered through this input, so when the Smoke Detector trips, the control will shut down the unit immediately. The control will have low voltage protection for the contactors and will not energize a contactor if the voltage is below 19.2 VAC, to insure contactor pull-in. If the control has a compressor contactor energized when the voltage drops, it shall not de-energize the contactor until the voltage drops below 16 VAC, which is the drop out voltage for most contactors. The control shall have a means of low ambient control without adding any additional components. The control shall have a means of cycling the compressor on for 10 minutes and off for 5 minutes to defrost the indoor coil when the outside ambient is below a low ambient switch point without adding additional components.
5. The control shall have a means of storing compressor run time. This data shall be available through communication. The control shall have the ability to clear this data when a compressor is replaced. The control shall have the ability to store a name of at least 26 characters in length. The control will leave the factory with the serial number of the equipment it is in, stored in non-volatile memory in the Name location. The control shall have the ability to store the model number of the equipment of at least 26

characters in length. The control will leave the factory with the model number of the equipment it is in, stored in non-volatile memory. The control shall have the ability to store the serial number of the equipment of at least 26 characters in length. The control will leave the factory with the serial number of the equipment it is in, stored in non-volatile memory.

6. The control shall not power the contactors through the thermostat wiring. Dropping voltage over the thermostat wiring causes chattering contactors when the contactors are powered in this manner. The control will operate and monitor up to 3 stages of heat independently. The control shall monitor the Gas Heat operation in the heating mode. It shall monitor the gas valve when there is a call for heating. The control shall alarm when there is a call for heat and no gas valve voltage after 5 minutes. There will only be one control board for this series of units, for both CV and VAV operation.

E. COMFORT CONTROL FEATURES

1. The control will be installed and tested at the factory where the equipment is assembled.
2. The control will use a Wall Senor that has a means of overriding the unoccupied mode for a programmable amount of time.
3. The Unoccupied Override time will be programmed in minutes up to 4 hours.
4. The control will use a Wall Sensor that has a warmer/cooler dial so the occupants can offset the programmed setpoint by a programmed amount between 1 and 5 degrees
5. The control will have a Supply Air Sensor as standard.
6. The control will have a Return Air Sensor as standard.
7. The control will have an Outside Air Sensor as standard.
8. The control will use the Return Air Sensor in place of the Space Sensor if the Space Sensor fails for any reason, the control will have a 365 day Real Time Clock.
9. The Real Time Clock will be able to do automatic Daylight Savings Time adjustment.
10. The control will have an Occupancy Schedule that allows two different Occupied schedules per day for each of the seven days of the week individually.
11. The control will have 20 Holiday Schedules, each capable of 99 days.
12. The control's Holiday Schedules will have a start time associated with each schedule.
13. The control will control the Economizer directly.
14. The control will be capable of operating the Economizer using Dry Bulb, Outside Enthalpy, or Differential Enthalpy.
15. When the control is using Enthalpy to control the Economizer, it will also have an Outside Air Temperature enable Setpoint.
16. The control will use two setpoints for Supply Air Temperature for the Economizer operation. One will be for a small space cooling demand and one for a large space cooling demand.
17. The control will have the ability to do Demand Ventilation using one CO_2 sensor.
18. The control will have a programmable maximum Outside Air Damper Position for IAQ operation.
19. The control will have the ability to temper the ventilation air during times when heating or cooling is not required.
20. The control will have the ability to offset the operating setpoint based on high Humidity in the Space.
21. The control will have programmable limits when offsetting the Operating Setpoint to control Humidity.\
22. The control must be able to lockout Cooling below a programmable Outside Air Temperature Setpoint.

23. The control will be able to lockout Heating above a programmable Outside Air Temperature Setpoint.
24. The control will have a Space Temperature Alarm.
25. The control will have a Supply Air Temperature Alarm for Heating and Cooling. The Alarm temperature will be programmable.
26. The Control will be able to do a Pre-Occupancy Purge at a Programmable Time.
27. The control will have a hardware Smoke-Purge input.
28. The control will have the ability to read a dirty filter switch
29. The control will have the capability of reading a Fan proving switch.
30. The control will have an intelligent recovery function that will bring the space to the Occupied Setpoint just before or at the beginning of the first Occupied schedule each day. The control will learn and apply the minimum run time required to heat or cool the space to setpoint for the first Occupied period of a day.
31. The control will have Software controllable Mode Switches (Heat, Cool, and Fan).
32. The control will meter and track Unoccupied Override Time for billing purposes.

F. OPTIONAL SIMPLICITYLINC™ TRANSLATOR

1. The unit shall have an optional SimplicityLINC™ translator as an interface between a BACnet® control system and devices that communicate using the Modbus® RTU protocol. The SimplicityLINC™ shall be preconfigured to provide an interface to YORK UPG products equipped with an Intelli-Comfort™ or Simplicity Elite™ controller and allow monitoring and control by a third-party BACnet® Building Automation System (BAS).

2.47 Heat Recovery Ventilators- Exterior

A. General units shall be a packaged static plate enthalpic-energy recovery ventilator as manufactured by RenewAire technology or equal in a cabinet weatherized for outdoor use.

B. Quality Assurance

1. The energy recovery cores used in these products shall be certified by ARI under its Standard 1060 for Energy Recovery Ventilators. ARI published certifications shall confirm manufacture's published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently ARI Certified will not be accepted.
2. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA 90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.
3. Unit shall be listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers.
4. The RenewAire core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten years from the date of purchase. Balance of Unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two years from the date of purchase.

C. Energy Transfer

1. Shall be capable of transferring both sensible and latent energy between air streams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to

the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.

D. Passive Frost Control

1. Energy-transfer element shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional extreme conditions shall not affect the usual function or performance of the element. No condensate drains will be allowed.

E. Continuous Ventilation

1. Unit shall have the capacity to operate continuously without the need for bypass, recirculation, preheaters, or defrost cycles under normal operating conditions.

F. Positive Airstream Separation

1. Water vapor transfer shall be through molecular transport by hydroscopic resin and shall not be accomplished by "porous plate" mechanisms. Exhaust and fresh airstreams shall at all times travel in separate passages, and airstreams shall not mix.
2. Laminar Flow
Airflow through the energy exchange element shall be laminar, avoiding deposition of particulates on the interior of the energy exchange plate material.

G. Construction

1. Energy-exchange module shall be of fixed-plate cross-flow construction, with no moving parts.
    a. No condensate drain pans or drains shall be allowed and unit shall be capable of operating in winter and summer conditions without generating condensate.
    b. Case shall be constructed of galvanized, 20-gauge steel, with lapped corners, and gasketed, zinc plated screw fasteners.
    c. Unit shall have single-point power connection.
    d. No Speed Control Allowed. External blower speed controls shall not be used.
4. Flange components shall be provided suitable for connection of ductwork.
5. Access door shall provide easy access to blowers, energy transfer elements, and filters. Panel shall be gasketed to provide air-tight seal.
6. Case walls and doors shall be insulated with 1" FSK high-density board insulation, eliminating the possibility of exposing the fresh air to glass fibers.
9. Energy-exchange element shall be protected by 30% efficient 2" nominal pleated, disposable filters.
10. Weatherhoods shall be screened to exclude birds and animals. Inlet weatherhood shall be sized to maintain inlet velocities below 500 fpm, and equipped with rain excluder baffles.
11. Blower motors shall be thermally protected with automatic reset, or supplied with starters.

H. Configuration

1. Unit shall be available from factory with vertical return air and vertical supply air duct connection openings.

I. Options

1. Non-pitched roof curbs shall be available from the factory for use with all configurations of the rooftop series units.
2. Units shall be capable of continuous 24/7 operation in winter and summer and just exhaust during economizer operation through remote, wall mounted switch and through contacts for control by BMS system.

2.48 BUILDING HOT WATER BOILERS AND ACCESSORIES

A. This Section includes gas-fired, condensing cast-iron boilers for heating hot water.

1. Related Sections include the following:
   a. "Breechings, Chimneys, and Stacks" for connections to breechings, chimneys, and stacks.
   b. Sections for control wiring for automatic temperature control.
2. Submittals shall include
   a. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated.
   b. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, and method of field assembly, components, and location and size of each field connection.
   c. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
   d. Source Quality Control Tests and Inspection Reports: Indicate and interpret test results for compliance with performance requirements before shipping.
   e. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
   f. Maintenance Data: Include in the maintenance manuals specified in Division 1. Include parts list, maintenance guide, and wiring diagrams for each boiler.
3. Quality Assurance shall include
   a. ASME Compliance: Boilers shall bear ASME "H" stamp and be National-Board listed.
   b. FM Compliance: Control devices and control sequences according to requirements of FM.
   c. Comply with NFPA 70 for electrical components and installation.
4. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."
5. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents. Installing contractor shall provide one year of warranty parts and labor.
   a. Special Warranty: Submit a written warranty, executed by the contractor for the heat exchanger.
   b. Warranty Period: Manufacturer's standard, but not less than 10 years from date of Substantial Completion on the heat exchanger. Warranty shall be non-prorated and not limited to thermal shock. Additional 21-year thermal shock warranty on heat exchanger.

B. Boilers shall be CSA design certified as a condensing boiler. Boilers shall be designed for a minimum of 5:1 continuous turn down with constant CO2 over the turndown range. The boiler shall operate with natural gas and have a CSA International certified input rating as noted on

the drawings, and a thermal efficiency rating up to 99% at minimum input. The boiler shall be symmetrically air-fuel coupled such that changes in combustion air flow or flue flows affect the BTUH input without affecting combustion quality. The boiler will automatically adjust input for altitude and temperature induced changes in air density. The boiler will use a proven pilot interrupted spark ignition system. The boiler shall use a UL approved flame safeguard ignition control system using UV detection flame sensing. The UV detector shall be air cooled to prevent condensate formation and so designed as to prevent misalignment. The design shall provide for silent burner ignition and operation. The boiler shall be down fired counter flow such that formed condensate always moves toward a cooler zone to prevent re-evaporation. An aluminum corrosion resistant condensate drain designed to prevent pooling and accessible condensate trap shall be provided. In some jurisdictions, a means of neutralizing the condensate Ph levels may be required. Boiler shall be able to vent a horizontal distance of 80 equivalent feet with a vent diameter equivalent to the combustion chamber outlet diameter.

1. Service Access: The boilers shall be provided with access covers for easily accessing all serviceable components. The boilers shall not be manufactured with large enclosures, which are difficult to remove and reinstall. All accesses must seal completely as not to disrupt the sealed combustion process. All components must be accessible and able to adjust with the removal of a single cover or cabinet component.
2. Indicating lights: Each boiler shall include a diagnostic control panel with a full text display indicating the condition of all interlocks and the BTUH input percentage. Access to the controls shall be through a completely removable cover leaving diagnostic panel intact and not disrupted.
3. Manufacturers: Manufacturer shall be a company specializing in manufacturing the products specified in this section with minimum five (5) years experience. Hydrotherm (a Mestek Company) is the basis of design. Listed acceptable manufacturers shall be subject to compliance with requirements. Provide boilers by one of the following:
   a. Aerco Benchmark BMK-2.0
   b. Viessmann Vertomat

C. Components shall include

1. Combustion Chamber: The combustion chamber shall be constructed of cast-iron. It shall be a down-fired design utilizing lightweight refractory around the burner housing.
2. Heat Exchanger: Boilers shall be a cast iron sectional unit designed for pressure firing and shall be constructed and tested for 100 P.S.I water working pressure, in accordance with the A.S.M.E. Section IV Rules for the Construction of Heating Boilers. Individual sections will have been subjected to a hydrostatic pressure test of 250 PSIG at the factory before shipment and they shall be marked, stamped or cast with the A.S.M.E. Code symbol. Boilers with less than 250-psi pressure test will not be acceptable for this project. The sections shall be of a down fired counter flow single-pass design. Water ports will be sealed with graphite port connectors. The sections will be fully machined for metal to metal sealing of the gas side surfaces. The design will provide for equal temperature rise through all sections. The heat exchanger shall be designed to prevent fluid boiling. The iron shall have a minimum thickness of ¼". The heat exchanger design should have no limitations on temperature rise or restrictions to inlet water temperature and a Cv of 60 (KN-6), 100 (KN-10), and 190 (KN-20).
3. Jackets: Stainless Steel.
4. Gas Burner: The burner shall be metal fiber mesh construction, allowing high turndown of the fuel-air mixture. The burner flame shall burn horizontally and be of the pre-mix type with a forced draft fan. Burner shall fire to provide equal distribution of heat throughout the entire heat exchanger. The burner shall be easily removed for

maintenance without the disruption of any other major component of the boiler. A window view port shall be provided for visual inspection of the boiler during firing. The gas distribution components and burner shall be enclosed with a cast-aluminum housing.

5. Ignition components: The ignition hardware shall consist of Alumina ceramic insulated ignition electrodes and UV sensing tube permanently arranged to ensure proper ignition electrode and UV alignment.
6. Rated Capacity: The boiler shall be capable of operating at rated capacity with pressures as low as 2" W.C. at the inlet to the burner pressure regulator.

D. The burner shall be capable of 99% efficiency without exceeding a Nox reading above 11ppm. The burner and gas train shall be provided with the following trim and features:
   1. Burner Firing: Full modulation with 5:1 turndown @ Continuous CO2
   2. Burner Ignition: Interrupted spark
   3. Safety Controls: Energize ignition, limit time for establishing flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, and allow gas valve to open.
   4. Flue-Gas Collector: Enclosed combustion chamber with integral combustion-air blower and single venting connection.
   5. Gas Train: Manual gas valves (2), main gas valve (solenoid), manual test and check valves, pilot gas pressure regulator, and automatic pilot gas valve. All components to be factory mounted and CSD-1 compliant.
   6. Safety Devices: Low gas pressure switch, air-flow switch, and blocked flue detection switch, low water cutoff (manual reset), high temperature manual reset. All safeties to be factory mounted.
   7. Individual gas regulator provided by factory, shipped loose for field installation, one per boiler.

E. Controls: The boiler control package shall be a MTI Heat-Net or equivalent, integrated boiler management system. The control system must be integral to each boiler, creating a control network that eliminates the need for a "wall mount" stand-alone boiler system control. Additional stand-alone control panels, independent of a Building Management System (BMS), shall not be allowed to operate the boiler network.

   1. The Heat-Net control shall be capable of operating in the following ways:
      a. As a stand-alone boiler control system using the Heat-Net protocol, with one "Master" and multiple "Member" units.
      b. As a boiler network, enabled by a Building Management System (BMS), using the Heat-Net protocol, with one "Master" and multiple "Member" units.
      c. As "Member" boilers to a Building Management System (BMS) with multiple input control methods.
   2. A boiler becomes a Master when a resistance type 10K sensor is connected to the J10 "SYS/DHW HEADER" terminals. The sensor shall be auto detected. The Master senses and controls the header/loop temperature utilizing a system setpoint. It uses any boilers it finds "Heat-Net Members" or those defined in the control setup menus to accomplish this. The "Master" shall also have the option of monitoring Outside Air Temperature "OA" to provide full outdoor air reset functionality. Only one master shall be allowed in the boiler network.
      a. When operating as a "Master", the Heat-Net control provides a stand-alone method using a PID algorithm to regulate water temperature. The algorithm allows a single boiler "Master" or multiple "Master + Member" boilers in a network of up to 16 total boilers.

b. The control algorithm is based upon a control band, at the center of which is the setpoint. While below the control band, boilers are staged on and modulated up until the control band is entered. Once in the control band, modulation is used to maintain setpoint. Optimized system efficiency is always accomplished by setting the Modulation Maximum "Mod-Max" setting to exploit each boiler in the network's inverse efficiency curve. The control shall operate so that the maximum number of boilers required, operate at their lowest inputs until all boilers are firing. Once all boilers are firing, the modulation clamp is removed and all boilers are allowed to fire above this clamped percentage up to 100%. This "boiler efficiency" clamp is defaulted to 80% and thus limits all the boilers individual outputs to 80% until the last boiler fires. The 80% default must be field adjustable for varying operating conditions. All boilers modulate up and down together always at the same modulation rate. Boilers are shut down only when the top of the band is breached, or before the top of the band, if the control anticipates that there is a light load. Timers shall also be included in each control in the network to prevent any boiler from short cycling.

3. Additional boilers in the network always default to the role of member. The lack of sensors connected to the J10 terminals "SYS/DHW Header" on each additional boiler shall ensure this.
   a. Each "Member" shall sense its supply outlet water temperature and modulate based on signals from a Building Management System (BMS) or "Master" boiler. When operating as a member, starting, stopping, and firing rate shall also be controlled by the "BMS" or "Master" boiler.
   b. When using the Heat-Net protocol, the system setpoint shall be sent from the "Master", along with the modulation value to control firing rate. It also receives its command to start or stop over the Heat-Net cable. Each "Member" will continuously monitor its supply outlet temperature against its operating limit. If the supply temperature approaches the operating limit temperature (adjustable), the boilers input control rate is limited and its modulation value decreases to minimize short cycling. If the operating limit is exceeded, the boiler shall shut off.

F. Each Heat-Net control in the boiler network shall have the following standard features:

1. Digital Communications Control.
   a. Boiler to Boiler: Heat-Net
   b. Building Management System (BMS) with MODBUS standard protocol and BACNET and LONWORKS as optional protocols.
2. Analog 4:20 and 0-10vdc also supported.
3. Distributed control using Heat-Net protocol for up to 16 total boilers.
4. System/Boiler operating status in English text display.
5. Interlock, Event, and System logging with a time stamp.
6. Advanced PID algorithm optimized for specific boilers (KN-Series).
7. Four dedicated temperature sensor inputs for: Outside Air Temperature, Supply (Outlet) Temperature, Return Temperature (Inlet), and Header Temperature.
8. Automatically detects the optional temperature sensors on start up.
9. Menu driven calibration and setup menus with a bright 4-line Vacuum Fluorescent Display.
10. (8) Dedicated 24vac interlock monitors and 8 dedicated 120vac system monitors used for diagnostics and providing feedback of faults and system status.
11. Multiple boiler pump or motorized boiler valve control modes.
12. Combustion Air Damper control with proof time.

13. Optional USB/RS485 network plug-in to allow firmware updates or custom configurations.
14. Optional BACNET and LONWORKS interface.
15. Alarm contacts.
16. Runtime hours.
17. Outdoor Air Reset with programmable ratio.
18. Time of Day clock to provide up to four (4) night setback temperatures.
19. Failsafe mode when a Building Management System (BMS) is controlling setpoint. If communications is lost, the boiler/system shall run off the Local Setpoint.

G. Boiler Trim Shall Include

1. Safety-Relief Valve: ASME rated, factory set to protect boiler and piping as per schedule/drawings. 100 psi maximum allowable working pressure
2. Gauge: Combination water pressure and temperature shipped factory installed. LCD outlet temperature readout to be an integral part of the front boiler control panel display to allow for consistent easy monitoring of temperatures factory mounted and wired.
3. Burner Controls: Boiler shall be provided with a Honeywell RM7800 series digital flame safe guard with UV rectification. The flame safe guard shall be capable of both pre and post purge cycles.
4. High Limit: Temperature control with manual-reset limits boiler water temperature in series with the operating control. High Limit shall be factory mounted and sense the outlet temperature of the boiler through a dry well.
5. The following standard trim:
   a. Aluminum Condensate Receiver Pan
   b. Low Air Pressure Switch
   c. Blocked Flue Detection Switch
   d. Modulation Control
   e. Temperature/Pressure Gauge
   f. Manual Reset High Limit
   g. Low Gas Pressure Safety Switch
   h. Low Water Cutoff with Manual Reset (CSD-1)
   i. Gas Pressure Regulator to provide 4” Incoming Pressure to Main Gas Valve – Shipped Loose for Field Installation.
   j. Air inlet filter
   k. Supply Outlet Temperature Display
   l. Full Digital Text Display for all Boiler Series of Operation and Failures
   m. Air Inlet Filter
   n. Variable Frequency Drive and Combustion Air Fan with Safety Interlock
   o. Condensate Drain
6. PROVIDE THE FOLLOWING JOB SPECIFIC TRIM AND FEATURES
   a. High Gas Pressure Switch and Valve Proving Switch for IRI Compliant GasTrain
7. Boiler Blower Motor: Blower motor shall be externally mounted for ease of service. There shall be no requirement to remove covers or gas train components to remove the blower motor. The KN-10 Blower shall be .5 HP and FLA not to exceed 8 Amps.
8. Test and inspect boilers according to the ASME Boiler and Pressure Vessel Code, Section IV. Boilers shall be test fired in the factory with a report attached permanently to the exterior cabinet of the boiler for field reference.

H. Installation

1. Examine area to receive boiler for compliance with requirements for installation tolerances and other conditions affecting boiler performance. Do not proceed with installation until unsatisfactory conditions have been corrected.

2. Install boilers level and plumb, according to manufacturer's written instructions and referenced standards.
3. Install gas-fired boilers according to NFPA 54.
4. Support boilers on a minimum 4-inch thick concrete base, 4 inches larger on each side than base of unit.
5. Install electrical devices furnished with boiler, but not specified to be factory mounted.
6. Connect gas piping and individual regulator, full size, to boiler gas-train inlet with union.
7. Connect hot water piping to supply and return boiler tappings with shutoff valve and union or flange at each connection.
8. Install piping from safety-relief valves to nearest floor drain.
9. Connect breeching to boiler outlet, full size of outlet. The boiler shall operate under positive (Category IV) or negative (Category II) stack pressure. Vent material must be listed AL29-4C Stainless Double Wall Stack for condensing appliances.
10. Electrical: Comply with applicable requirements in Division 16 Sections.
    a. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

I. Set Up

1. Manufacturer's Field Service: Engage a factory-authorized service representative to supervise the field assembly of components and installation of boilers, including piping and electrical connections. Report results in writing.
    a. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Boiler shall be commissioned by factory-authorized technician. Contact local representative for factory authorized technician information.
2. Manufacturer’s representative shall supply a factory authorized service technician to start up the boilers.
3. Flush and clean boilers on completion of installation, according to manufacturer's written instructions.
4. After completing boiler installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes including chips, scratches, and abrasions with manufacturer's stainless steel polish.

J. Start Up
1. Engage a factory-authorized service representative to provide startup service. Start up to be performed only after complete boiler room operation is field verified to offer a substantial load, and complete system circulation. One-year warranty shall be handled by factory authorized tech.
2. Verify that installation is as indicated and specified.
    a. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16 Sections. Do not proceed with boiler startup until wiring installation is acceptable to equipment Installer.
3. Complete manufacturer's installation and startup checklist and verify the following:
    a. Boiler is level on concrete base.
    b. Flue and chimney are installed without visible damage.
    c. No damage is visible to boiler jacket, refractory, or combustion chamber.
    d. Pressure-reducing valves are checked for correct operation and specified relief pressure. Adjust as required.
    e. Clearances have been provided and piping is flanged for easy removal and servicing.

f. Heating circuit pipes have been connected to correct ports.
g. Labels are clearly visible.
h. Boiler, burner, and flue are clean and free of construction debris.
i. Pressure and temperature gages are installed.
j. Control installations are completed.

4. Ensure pumps operate properly.
5. Check operation of gas pressure regulator device on gas train, including venting.
6. Check that fluid-level, flow-switch (optional), and high-temperature interlocks are in place.
7. Start pumps and boilers, and adjust burners to maximum operating efficiency.
   a. Fill out startup checklist and attach copy with Contractor Startup Report.
   b. Check and record performance of factory-provided boiler protection devices and firing sequences.
   c. Check and record performance of boiler fluid-level, flow-switch (optional), and high-temperature interlocks.
   d. Operate boilers as recommended or required by manufacturer.
8. Perform the following tests for maximum and minimum firing rates for modulating burner. Adjust boiler combustion efficiency at maximum and minimum modulation rates. Perform combustion flue gas test at minimum and maximum modulation rate. Measure and record the following:
   a. Differential pressure across air / gas orifice.
   b. Combustion-air temperature at inlet to burner.
   c. Flue-gas temperature at boiler discharge.
   d. Flue-gas carbon dioxide, oxygen, and carbon monoxide concentration.
   e. Flue gas Nox emissions where applicable.
   f. Natural flue draft.
9. Measure and record temperature rise through each boiler.

K. Training

1. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
   a. Operate boiler, including accessories and controls, to demonstrate compliance with requirements.
   b. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
   c. Review data in the maintenance manuals. Refer to Division 1 Section "Contract Closeout."
   d. Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
   e. Schedule training with Owner with at least 7 days' advance notice.

2.49 PIPING, FITTINGS, AND JOINTS

A. Provide all piping, fittings, flanges, unions, bolting, gaskets, welding, threading and soldering for main piping network, branches and connections to equipment.
B. All piping shall be clearly marked with material specification.
C. All pipe and material shall comply with the requirements and recommended practices of ASME B31.9 Building Services Piping Code.
D. Provide drains at low points and vents at high points of all piping systems and between pumps and check valves.

E. Hot water and steam piping shall be Schedule 40 Steel for pipe sizes 2-1/2 and greater; Schedule 40 Copper for sizes 2” or less. Condensate piping shall be Schedule 80 for all sizes. All drain piping shall be Copper.

2.50 AIR VENTING AND DRAINAGE

A. Grade all piping for drainage through equipment or through accessible drain valves so that system can be conveniently freed of water by gravity flow.
B. All high points in closed water piping systems shall be relieved of air through accessible manual vents on the high points of the pipe lines and at the equipment.
C. Vent valves on piping and equipment shall be 1/2" ball valves with chains and caps and with discharge pipes to convenient points for catching discharge.

2.51 THERMOMETERS, GAUGES AND PRESSURE/TEMPERATURE TAPS

A. Provide thermometers and gauges as shown on the drawings, and at inlets and outlets of all air handling unit coils, at pumps, etc. Provide pressure taps and thermometer wells for all in-duct or in-box water coils.

2.52 INSULATION

A. All insulation materials, finishes, coatings, cements, jackets and other insulation accessories shall have minimum composite or individual fire hazard ratings as well as thickness and "C" values conforming to State Building Codes which control building construction materials that may be used on this project. Where specification requirements exceed the Code requirements, the specification shall govern. Insulation shall be as manufacturer by Owens Corning, John Manville, Armstrong or approved equal.

B. Insulation for the various systems and associated equipment shall be composed of materials, which are non-combustible and/or provide a fire resistive system of insulation, which complies with the applicable Code having jurisdiction.

C. Insulation Fire hazard ratings shall not exceed Flame Spread Rating 25, Smoke Developed Rating 50.

D. Hot water piping, low pressure steam and boiler blow-down pipe insulation shall be 1-1/2” for Hot water pipe sizes up to 2” and 2” for pipe sizes greater than 2”. All insulation shall have All-service-jacket facing.

E. Medium and High pressure Steam and Condensate piping insulation shall be 2-1/2” for sizes up to 2” and 3” for sizes graeter than 2”. Interior MPS & LPS shall have a jacket of A finish jacket of H.K. Porterlag Lagging Cloth having a treated weight of 16 oz./sq.yd. Exterior HPS and PC piping shall be double thickness with aluminum jacket. Aluminum jacket shall be 0.020 inch thick conforming to ASTM B-209 with a 3 mil factory applied polykraft moisture barrier.
F. Drain piping, refrigeration and cold water make-up insulation shall be 1”.

G. All piping within mechanical room and in exposed areas shall have Cell Co plastic jacket.

H. Supply ductwork shall be 1-1/2” fiber board insulation. Ductwork insulation shall have FSKL facing 0.35 mil aluminum foil reinforced with fiberglass yarn reinforcing scrim and laminated to chemically treated fire resistive Kraft paper having a minimum 35 pound per inch width tensile strength when tested in accordance with ASTM D 828. Longitudinal laps and butt strips shall be a minimum of 3 inches. duct installation, sealing and testing is completed by the

Mechanical Contractor Ductwork insulation exposed to weather shall be insulated with 2 inch thick fiber glass rigid board insulation with vapor barrier Exterior insulation shall also be be covered with EPDM roofing material with the joints overlapping minimum of 6 inches. All joints shall be staggered and shall be covered with mastic to ensure a weatherproof system.

2.53 AIRE DISTRIBUTION DEVICES

A. General - Provide diffusers, registers and grilles as shown and scheduled on the drawings and herein specified. Diffusers shall be as manufactured by Tuttle & Bailey, MetalAire or approved equal.

B. All diffusers, grilles and registers shall be equipped with factory mounted opposed blade dampers. All air distribution devices shall be of steel or aluminum construction unless otherwise specified herein or scheduled on the drawings.

C. Ceiling Supply - Ceiling or sidewall supply air diffusers of the above types shall be of the restricted multi-orifice jet induction and air mixing type, consisting of louvered sections with built-in diffusing vanes, as manufactured by Tuttle & Bailey Type RCTC or MetalAire Series 5000 IV.

D. Return and Exhaust - General return/exhaust registers shall be equal to Tuttle & Bailey Model T77D or MetalAire Model RHD. All return and exhaust registers installed in all toilet rooms, locker rooms and showers, and other areas subject to moisture shall be similar to above except constructed of all aluminum , including opposed blade dampers, equal to Tuttle & Bailey Model A77D.

E. Sidewall Adjustable Supply - Sidewall supply registers shall be equal to Tuttle & Bailey Model T547 or MetalAire Model H4004SD,

F. Linear Supply and Return – Linear supply and return diffusers shall be equal to Tuttle & Bailey Model EH or MetalAire Model 2000D.

2.54 FINNED TUBE RADIATION

A. Furnish and install where shown on the plans, finned tube radiation as manufactured by Sterling, Vulcan, Slant-Fin, or approved equal. Ratings shall be IBR approved.

B. Heating element type and capacity shall be as scheduled on plans. The element shall be seamless copper tubing, mechanically expanded to aluminum fins.

C. Brackets and hangers shall be 14 gauge, galvanized steel, channel type. Silent horizontal movement during expansion and contraction shall be provided by 18 gauge element support cradle. Bracket shall interlock with backplate channel and provide full engagement enclosure lock.

D. Full backplate shall be 20 gauge steel with mounting channel and slots for mounting brackets.

E. The enclosure shall be 16 gauge steel of style shown on plans, and shall be (baked primer finish suitable for field painting) (baked enamel finish in color selected by Architect from standard color charts. Submit color charts with shop drawings). Welded male and female slip joints are to

be provided for positive engagement and alignment of enclosures. Internal 14 gauge gussets (minimum of two) are to be welded at each end of enclosure.All necessary trim is to be provided for a completely finished job.

F. All covers shall run wall-to-wall or wall-to-end cap, as applicable or as required. Provide access door, or easily removable access section for each control or shut-off valve. Door shall require tool for opening. Dampers shall be provided, when indicated on plans, shall have rolled edges and be knob operated.

G. Zone Valves And Thermostats

1. Valves shall be as manufactured by Erie Valve Company, Honeywell or equal, □", 24 V, with 40 VA transformer for each thermostat.
2. Thermostat shall be 24 V with 50 □F to 85□F range and valves.

H. Self-Contained Control Valves

1. Thermostatic heating control valves shall be furnished and installed where shown on the drawings. Sizes of valves shall be to suit the capacity of the heating element indicated.
2. Control valve shall be automatic, self-contained, nonelectric, modulating type as manufactured by Danfoss, Macon, or Taco.
3. The control unit shall consist of one stainless steel bellow, and one beryllium copper bellow, nickel-plated copper sensor, and plastic knob.
4. Valve body available in angle or straightway pattern for hot water or low pressure two pipe steam. The valve body shall be with stainless steel disc, seat, and return spring.

2.55 AUTOMATIC SMOKE AND FIRE DAMPERS

A. H&V Subcontractor shall furnish and install where shown on the plans, combination fire and smoke dampers constructed and tested in accordance with UL 555. Each damper shall possess a 1 □perhour fire protection r motor shall have sufficient torque characteristics to operate the size damper indicated.

1. Damper motors shall be furnished as an integral part of the damper by the manufacturer. Damper motors shall be spring return type that allow dampers to close on power interruption and shall require 120 VAC power to open. Motors shall be completely installed and linked ready to operate the damper. Motors shall be installed inside of the duct systems and shall be removable for service or replacement.
2. Dampers shall be combination fire and smoke dampers capable of being mechanically reset.
3. Units shall be signaled from a smoke detector. The smoke detector and related wiring shall be by the Electrical Contractor. The dampers and motor operator shall be furnished and installed by the H&V Contractor, wired by the Electrical Contractor.
4. Dampers shall be Prefco Products, Inc., Model No. 5030 or similar by Phillips or Ruskin.
5. Installation diagram shall be provided with submittal.

B. Smoke Exhaust Control: (System No. 1)

1. On sensing of smoke by smoke detector (located in corridor and furnished and installed by Electrical Subcontractor), all return air automatic dampers shall close, except on floor of incidence.
2. At same time, the automatic damper in supply air register at floor of incidence shall close to preset maximum position, the remainder being left open. Supply air fan shall continue to operate.
3. The automatic damper in return air duct shall close; outside air damper shall open fully; and damper to smoke exhaust fan shall open. Smoke exhaust fan shall operate.
4. A reset switch (furnished and installed on fire panel by Electrical Subcontractor) shall reset dampers to normal positions and shutoff smoke exhaust control.
5. All of the wiring for this system shall be furnished and installed by the Electrical Subcontractor to provide this sequence of control. The Mechanical Subcontractor shall coordinate with the Electrical Subcontractor.
6. Unit smoke detectors shall shut down unit.
7. Dampers shall be Prefco Products, Inc., Model No. 5030 or similar by Phillips or Ruskin.
8. Installation diagram shall be provided with submittal.

C. Smoke Exhaust Control: (System No. 2)

1. On sensing of smoke by smoke detector (furnished and installed by the Electrical Subcontractor), corridor makeup air unit shall stop.
2. At same time, the automatic damper in exhaust air register at floor of incidence shall open, the reminder being left closed and smoke exhaust fan shall operate.
3. A reset switch (furnished and installed on the fire panel by the Electrical Subcontractor) shall reset dampers to normal positions, shutoff smoke exhaust fan, and start corridor makeup air unit.
4. All of the wiring for this system shall be furnished and installed by the Electrical Subcontractor to provide this sequence of control. The Mechanical Subcontractor shall coordinate with the Electrical Subcontractor.

3 PART 3-EXECUTION

3.1 WORKMANSHIP

A. All work shall be coordinated with the work to be installed by other sections of these specifications.

B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.

C. All duct supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this section.

D. Nameplates, catalog numbers, and rating identifications shall be securely attached to equipment.

E. The work shall be performed in a timely manner so as to cause no delay in the overall job progress. The Contractor shall cooperate with the other trades so that the work is installed in the most beneficial sequence for expeditious project completion.

F. Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

G. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment

H. Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electrical Code (NEC).

I. All wiring shall be verified for its integrity to ensure continuity and freedom from shorts and grounds

J. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.2 CLEANING OF SYSTEMS AND PREMISES

A. Before the systems are tested and balanced, all ducts serving the area under construction shall be cleaned so that no dirt, dust or other foreign matter will be carried through or deposited in the systems or the space served by the duct systems.

B. At all times keep the premises clear of rubbish.

C. Upon completion of the work in an area, remove all debris and rubbish resulting from the execution of this contract, and dispose of same. At anytime should the General Contractor be dissatisfied with the performance of the HVAC Contractor's clean up responsibilities, he may elect after notifying the HVAC Contractor to undertake this operation and to backcharge the HVAC Contractor accordingly.

3.3 HVAC CONTRACTOR'S WARRANTY

A. The HVAC Contractor shall provide a one year warranty against failure of the installed materials for any reason. The warranty shall cover the full costs of parts and labor required to remedy the defect, including, if necessary, replacement at the site, and shall run from the date of the Architect's acceptance of the system. The warranty shall also include provision for field inspection at no charge to the Owner, to verify failure, establish probable cause, and determine corrective action required. The HVAC Contractor shall furnish all service during the first year of operation. Any material that in the opinion of the architect, requires excessive service during the first year of operation shall be considered defective and will be replaced by the HVAC Contractor at no charge to the Owner.

B. The HVAC Contractor shall provide a listing of all manufacturer's commercial warranties provided by those manufacturers on their Materials. The list of these warranties must include the time period of each warranty. One copy each of those warranties shall be submitted with the listing.

C. The HVAC Contractor shall be responsible for warranting the testing, adjusting and balancing work for a period of one year after final date of completion. The HVAC Contractor shall also be responsible for all damage to existing systems as a result of the work performed. All damaged systems shall be repaired or replaced at the option of the Owner at no additional cost to the Owner. All such repair or replacement work shall be done immediately upon finding.

D. Warranty response to any malfunction shall be on a next day, normal working hour basis.

E. Work under warranty shall be performed by fully qualified workmen and/or technicians.

F. All guarantees and warranties required to be provided for the work in this Section shall begin their term on the date of final written acceptance of the entire system by the Owner.

3.4 SUBMITTALS

A. The capacity of each HVAC unit shall be substantiated by computer generated selection data or other detailed selection data provided by the manufacturer, for the specific conditions defined on the drawings. Submit 7 copies for approval.

1. The selection data shall clearly show the entering and leaving fluid conditions, the fluid flow volume and the fluid pressure drop through the unit, the ambient conditions, the heat rejection media entering and leaving conditions, the available external static pressure, the unit total static pressure, the airside pressure drops, the refrigerant and the saturated suction temperature, the required RPM of the unit, the motor horsepower, the motor voltage, the motor efficiency, the motor RPM, the motor type, the fuel efficiency, the fuel consumption rate, the maximum capacity, the part load performance data of the anticipated operation of the system, and the radiated sound ratings at design conditions as may be appropriate for any specific piece of equipment.

B. Contractor shall submit shop drawings indicating the method of supporting all units.

3.5 PERFORMANCE

A. The drawings are diagrammatic and the final arrangement of the work shall suit the existing and field conditions, the characteristics of the materials used and the instructions of the Engineer and/or the Architect.

B. The Contractor shall be responsible for repair of damaged or disturbed existing work or the work of other trades caused by his work, testing of his work or repair to his work.

C. All devices shall be installed in accordance with the manufacturer's recommendations, the Engineer's instructions and so as to provide all required access for cleaning, operation, repair and maintenance.

3.6 START UP

A. All equipment, systems, controls and units shall be started as part of a heating, ventilating and air conditioning system, in accordance with all manufacturers' recommendations.

B. Manufacturer's Representative shall start up the RTU chillers and boilers and all other major equipments.

3.7 RECTANGULAR DUCTS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

B. Sealing

All ductwork shall be sealed in accordance with the following table:

SMACNA SEAL CLASS	SEALING REQUIRED	SMACNA STATIC PRESSURE CONSTRUCTION CLASS
A	All transverse joints All longitudinal seams All duct wall penetrations	4" W.G. and up
B	All transverse joints All longitudinal seams	3" W.G.
C	All transverse joints	2" W.G. and down

1. For the purposes of these specifications sealing shall mean the following:
2. The use of adhesives, gaskets, liquids, mastics, hot melt sealant, pressure sensitive tape or combinations thereof to close openings in the surface of the ductwork and field erected plenums and casings through which air leakage would occur.
3. The requirements to seal apply to both positive and negative pressure modes.
4. Pressure sensitive tape shall only be acceptable for sealing ductwork which operates at a static pressure of ½" or less.

5. Liquid sealant shall only be acceptable for slip joints where metal clearances do not exceed 1/16".
6. Gaskets shall be used for all flanged connections and shall have an adhesive backing to adhere to the flange during assembly of the joint.

C. Reinforcement

1. Unless specified otherwise on the drawings rectangular ductwork shall be constructed and reinforced per the following "Rectangular Duct Reinforcement" tables, where the duct wall thickness, the reinforcement spacing and the rigidity class are specified by duct size and pressure classification. Rigidity class designations are based on the SMACNA standards for "Intermediate Reinforcement" and "Transverse Joint Reinforcement" as published in the SMACNA "HVAC DUCT CONSTRUCTION STANDARDS - Metal and Flexible".
2. Duct sides that are 19" and over and are 20 gauge or less with more than 10 square feet of unbraced panel shall be cross broken or beaded unless they are lined or externally insulated.
3. Fittings shall be reinforced similarly to sections of straight duct. On size change fittings the greater fitting dimension determines the duct gauge. Where fitting curvature or internal members provide equivalent rigidity, such features may be credited as reinforcement.
4. The duct side with the largest dimension shall determine the duct gauge.
5. Holes made in the duct walls for the passage of tie rods shall be of minimum size and shall be sealed in accordance with the required duct seal classification.
6. Where used tie rods shall be evenly spaced in the width of the duct dimension.

D. Transverse Joints

1. Transverse joints shall be selected and used consistent with the static pressure class, sealing requirements and duct support intervals for proper assembly.
2. Where bar or angle stock is incorporated in a joint it shall be secured.
3. Fasteners shall be steel and may be zinc or cadmium coated. They shall not project into duct more than ½".
4. Where bolts or welds are specified other types of fasteners shall not be used.

E. Seams

1. Seams shall be suitably selected for the material and pressure classification of the duct.
2. Seams shall be formed and assembled with proper dimension and proportion for tight and secure fit.

3.8 ROUND DUCTS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

B. Duct Gauge

1. Round ducts shall be constructed of the galvanized steel with duct walls in accordance with "SMACNA" standards.

3.9 FLEXIBLE DUCTS

A. Use

1. All flexible duct used on the supply air system shall be insulated with 1½" thick vinyl jacketed fiberglass insulation.

B. Length

1. The minimum length of flexible duct shall be used.
2. The maximum length of flexible duct in any single duct run shall be four feet.

C. Bends

1. Bends shall be made with not less than one and one half duct diameter centerline radius.
2. Maximum bend shall be 90^{o}.

D. Fastening

1. Secure flexible duct to collar or sleeve by peeling back jacket and insulation at end of flexible duct. Fit duct over collar or sleeve and clamp with ½" wide galvanized steel or stainless steel bands or clamps and matching seals. Pull jacket and insulation back in place and secure with two wraps of pressure sensitive sealing tape. Clamping device shall be two inches back from end of flexible duct. Seal with two wraps of duct tape.

I. Installation

1. Flexible duct is to be installed as straight as possible and as tight as possible.
2. Submittals shall include product data sheets as well as the manufacturer's recommended installation practices.

3.10 SUSPENSION OF DUCTWORK

A. Rigid round and rectangular ducts shall be installed with support systems as required to maintain alignment. Horizontal ducts shall have a support within two feet of each elbow and within four feet of each branch intersection.

B. Strap hangers on rectangular ducts may be used on ducts less than 60" wide if they are secured to the bottom of the duct with an approved fastener and with a minimum 1" tab below the duct, or with no fasteners if the strap is a single continuous loop.

C. Multiple trapeze hangers may be suspended from rod hangers to support ducts directly above and below each other if the rods are sized to support the combined load.

D. Round ducts less than 10" in diameter may be suspended by wire.

E. All hangers and trapezes shall be sized, spaced and selected in accordance with Section IV of SMACNA "HVAC DUCT CONSTRUCTION STANDARDS".

3.11 MISCELLANEOUS DUCT WORK REQUIREMENTS

A. Ductwork connected to intake or discharge louvers shall be painted inside for the first ten feet with bitumastic and pitched to a low point. The low point is to be provided with a 1½" copper drain piped by this trade to a building drain.

B. A gasket type joint shall be used where dissimilar metals are joined.

3.12 RECTANGULAR DUCT FITTINGS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

3.13 ROUND DUCT FITTINGS

A. Elbows larger than 8" shall be five piece welded construction.

B. Branch and take-off fittings shall be conical tee or conical reducing tee fittings.

C. Final connections to the individual terminal supply units shall be by means of flexible duct.

3.14 PIPE HANGERS, SUPPORTS, ANCHORS AND GUIDES

A. Contractor shall submit shop drawings indicating the method of supporting all piping furnished by this trade.

B. The Structural Engineer or Architect must approve the method of hanging before work is commenced.

C. Shop drawings of anchors shall be submitted before work is commenced.

D. Shop drawings of guides shall be submitted before work is commenced.

E. Sleeves of the specified type shall be installed wherever pipe lines penetrate walls, roofs, floors or partitions.

F. Sleeves shall be installed in accordance with the requirements of NFPA and the Massachusetts State Building Code.

3.15 VALVE TAGS

A. Valve tag scheme shall be approved by the Engineer prior to installation in the field and insertion on the record drawings.

B. Contractor shall provide a valve tag chart and clearly label the valve tags on the record drawings. The valve chart shall include but not be limited to: tag #, location, valve type, size, how valve operates (solenoid, modulating, manual).

C. Valve tags shall be securely fastened to the valve handle by heavy aluminum or brass hooks or chain.

3.16 VIBRATION ISOLATION

A. All equipment, piping, etc. shall be mounted on or suspended from approved foundations and supports, as specified herein or as shown on the drawings.

B. Mounting sizes shall be determined by the mounting manufacturer and the mountings shall be installed in accordance with the manufacturer's recommendations. The Contractor shall be responsible for the adequacy of the mountings to provide the minimum isolation efficiency required by these specifications or as specifically noted on the drawings.

C. Suspended centrifugal fans shall be installed on vibration isolation hangers.

3.17 PIPING SYSTEM INSTALLATION AND ASSEMBLY

A. All piping shall be installed at right angles to building surfaces, supports and structures.

B. Pipe welding shall performed by a certified welder with oxy-acetylene or electric arc in accordance with the latest revision of the applicable code, ASME Boiler Construction Code, ASA Code for Pressure Piping, or state and/or local codes which may supersede codes mentioned.

C. Threaded joints shall be made with Teflon tape only applied to male threads and care being taken to insure that the tape does not reach the interior of the pipe. All burrs and/or cuttings shall be removed and the pipe shall be reamed or filed out to not less than the original diameter. Piping shall be kept free from scale and dirt.

D. All pipe shall be straight, true and round without obstructions and with sharp, full cut threads or with ends beveled for welding.

E. Provide drain valves with hose connections at all low points and at the bottoms of all risers to allow for complete drainage of the system.

F. All openings shall be capped or plugged during construction to prevent dirt and/or rubbish from entering the piping.

G. Unions or flanged connections shall be placed wherever necessary to permit easy dismantling of the piping and equipment.

H. Where possible, piping shall be grouped together and supported in a neat and orderly manner.

I. Insulating bushings or dielectric nipples shall be provided between steel piping and copper piping on equipment.

J. Air vents shall be provided where indicated on the drawings and at all high points in the water systems.

K. Pipe must be supported before and after expansion compensation devices.

L. Mount all pressure gauges to be read from the floor.

M. Install pressure gauges on the suction and discharge of pumps.

N. Provide two spare pressure gauges of each pressure range and type.

O. Mount all thermometers to be read from the floor.

P. Install thermometers on the supply and return of the chill water system.

Q. Provide two spare thermometers of each range and type.

3.18 FLUSHING OUT TREATMENT

A. After completion of the installation of the piping system and prior to the start up of the systems, the system shall be flushed out with chemicals.

B. The flush out compound shall be trisodium phosphate, three percent by weight.

C. Flush out recirculation shall be for a period of not less than 48 hours.

D. Tests shall be performed following the chemical flushing out and a report shall be issued in writing to the Architect, stating that the cleaning and flushing has been completed satisfactorily.

E. Allowable chemical concentrations after flushing out shall be phosphate - zero, alkalinity - 100 parts per million maximum, suspended solids - zero.

3.19 DUCT INSULATION - DUCT WRAP

A. All work shall be in strict accordance with applicable codes and ordinances and the manufacturers recommendations.

B. All completed work shall be smooth in appearance.

C. Seams shall be stapled 6" on center with outward clinching staples and sealed with pressure sensitive aluminum foil tape.

D. All seams, joints punctures and tears shall be sealed with pressure sensitive aluminum, foil tape.

E. All make-up air ductwork, air conditioning supply ductwork, and ductwork connected to SF-1 shall be insulated. All exterior insulated ductwork shall be weather proofed per Section 2.7.

3.20 BALANCING DAMPERS

A. All branch ducts, balancing dampers shall be located as shown on the drawings or any place requiring one, in the following locations as a minimum: shall have a balancing damper.

1. All supply and return air branches from the trunks and all sub-branches from the mains shall have balancing dampers.
2. Branch duct connections from low pressure ducts to diffusers shall be made with dampered spin collars.

B. Locate dampers as far as possible from air outlets.

3.21 FINAL ACCEPTANCE

A. The Contractor shall leave all system components in proper working order, such as belt guards in place, access doors closed, doors to electrical switch boxes closed, thermostats restored to specified setting. All recorded data shall represent a true, actually measured, or observed condition. Any abnormal conditions in the mechanical systems or conditions which prevent total system balance, shall be reported to the Architect immediately upon finding. The Contractor shall permanently mark all dampers and other adjustment devices in a manner that will allow the settings to be restored.

B. The Contractor shall verify control system operation as specified, and shall report all system problems and malfunctions. The verification and checkout of the control system shall be accomplished during the heating and cooling cycles of operation for an appropriate period of time to assure control response and overall stability.

C. The Contractor shall verify that all air systems are in compliance with all standards, such as ASHRAE minimum outside air, and all other applicable codes and requirements.

D. All filters shall be replaced by the Contractor before commencing.

E. The Contractor shall make any necessary changes in fan speed, and shall realign all belts when necessary.

3.22 AIR AND WATER BALANCING

A. The HVAC Subcontractor shall employ an independent Balancing subcontractor, acceptable to and approved by the Architect/Engineer, to balance and adjust the air and water systems.

B. Balancing and adjusting shall not begin until all HVAC systems have been installed and are in full working order. Prior to the start of balancing, the following shall be checked:

1. Rotation of all fans and pumps.
2. Dampers are free to open and close
3. Fire and smoke dampers are open.
4. Clean filters are in place.

C. Upon completion of balancing and adjusting of the systems hereinafter specified, submit six (6) copies of the data for review and approval by the Architect/Engineer.

D. The balancing Subcontractor shall be procured early enough in the project to allow for him/her to review the project documents and determine if sufficient components are in place to balance and adjust the systems. The balancing subcontract shall provide a list of any deficient are he/she identifies.

E. Balancing Subcontractor shall provide all testing instruments, manpower, temporally connections and materials needed for balancing and adjusting of the air and water systems. All test instruments should have been calibrated within the last six (6) months. Balancing Subcontractor shall provide verification of calibration upon request.

F. Architect/Engineer and Owner shall be notified a minimum of five (5A) days prior to balancing commencing so that a representative can be available to witness the balancing work. In addition, the Balancing Subcontractor shall (upon completion of the balancing work and report submittal), at the request of the Architect/Engineer or Owner's representative, verify the balancing readings at four (4) locations. The locations shall be chosen by the Architect/Engineer or Owner's representative.

G. All balancing and adjusting of air and water systems shall be done in accordance without the latest edition of the NEBB procedural Standards for Testing, Adjusting and Balancing of Environmental systems or the latest edition of SMACNA's HVAC Systems Testing, Adjusting and Balancing.

H. Balancing of the cooling systems shall be performed in the air conditioning season, heating systems in the heating season.

I. Prior to balancing of the air and water systems, and as [art of the balancing report, the Balancing subcontractor shall prepare ductwork and piping schematics of the systems to be balanced. Schematics shall be similar to those indicated in the NEBB and SMACNA publications previously identified. Piping schematics shall be of similar content to ductwork schematics.

J. Air and Water Balancing Report forms shall be similar to the standard NEBB and SMACNA forms found in the previously identified manuals. The following information shall be provided at minimum (reports for equipment and systems not indicated shall be obtained from the NEBB/SMACNA manuals or prepared by the Balancing Subcontractor. Reports prepared by the Balancing Subcontractor shall be submitted for review and approval prior to final Balancing Report submittal):

    1. Air Apparatus Test Report
        a. Location.
        b. System Number.
        c. Manufacturer.
        d. Airflow, design and actual.
        e. Total CFM.
        f. Total Static pressure.
        g. Discharge Static Pressure.
        h. Suction Static Pressure.
        i. Coil pressure drops (static pressure).
        j. Filter pressure drops.
        k. Motor volts and amps.
        l. Outside Air and Return Air CFM.
        m. Drive data.
    2. Coil Test Report
        a. system Number.
        b. Location.
        c. Manufacturer.
        d. Airflow, design and actual.

e. Entering air temperature (DW/WB), design and actual.
f. Leaving air temperature (DW/WB), design and actual.
g. Water flow GPM, design and actual.
h. Entering water temperature, design and actual.
i. Leaving water temperature, design and actual.
j. Waterside pressure drop.
k. Airside pressure drop.
a.

3. Fan Test Report
   a. System Number.
   b. Location.
   c. Manufacturer.
   d. Airflow, design and actual.
   e. Total static pressure, design and actual.
   f. Inlet static pressure.
   g. Discharge static pressure.
   h. Motor and Drive data.
   i. Fan RPM.
   j. Voltage and Amperage.

4. Duct Traverse
   a. System zone/branch.
   b. Duct Size.
   c. Area.
   d. Design Velocity.
   e. Design Airflow.
   f. Test Velocity.
   g. Test Airflow.
   h. Duct Static Pressure.
   i. Air temperature.

5. Air Outlet Report
   a. Area Served.
   b. Outlet Number.
   c. Type.
   d. Size.
   e. AK factor.
   f. Velocity, design and actual.
   g. Airflow, design and actual.
6. Pump Test Report
   a. Unit Number.
   b. Manufacturer.
   c. Motor data.
   d. Voltage and amperage data.
   e. Waterflow, design and actual.
   f. Suction Pressure.

g. Discharge Pressure.
h. Total Head Pressure

K. The Balancing Subcontractor shall balance and adjust air and water systems to meet design requirements. ± 5%. Balancing shall be accomplished by adjusting dampers, drives, valves, etc. to obtain design requirements.

L. The HVAC subcontractor shall cooperate and make provisions for the Balancing Subcontractor as needed to accommodate the air and water balancing. As part of this Contract, the HVAC Subcontractor shall provide and/or change pulleys, belts, sheaves, valves and dampers, at no additional cost, in order to properly balance the systems to design requirements.

3.23 START UP AND TESTING OF COOLING EQUIPMENT

A. All HVAC equipment must start up by manufacture rep and report shall be generated on manufactures letter head.

B. All cooling equipment shall be tested to verify that the equipment operates mechanically and electrically as specified.

C. The Contractor shall verify that all operating and safety controls are correctly adjusted.

D. The Contractor shall verify that the cooling equipment controls are operating properly.

E. Tests shall be made to verify that the capacity control is fully modulating according to the required load, and that all control valves are operating according to the specifications. Tests shall be made at minimum load, 50% load, 100% load and various other loads throughout the modulating cycle.

F. The Contractor shall record the following non-test data:

1. Equipment designation number.
2. Equipment manufacturer.
3. Model number.
4. Serial number.
5. Rated input.
6. Rated output.
7. All other pertinent data.

G. The Contractor shall perform and record the following to meet minimum requirements:

1. Verify proper system operation.
2. Verify that the cooling system controls are operating according to design specifications.
3. All other measurements required for complete system testing.

H. The Contractor shall calculate the system coefficient of performance as measured. All calculations made using the measured data shall be included in the report. In general, the Contractor shall complete all tests necessary for complete cooling system analysis.

3.24 SEQUENCES OF OPERATION

A. Boilers Sequence of Operation:

1. The heating shall be inoperative as long as the outdoor temperature is above the setting on the outdoor thermostat (supplied). When the temperature drops below this setting, (usually 65ºF), the "S" control is energized, the heating boilers and the system circulator are energized. The "S" control shall automatically fire the heating boilers as they are needed to maintain the reset water temperature to the system as dictated by outdoor temperature.
2. When the outdoor temperature reaches 65ºF (adjustable), the circulators and the "S" control is de-energized, leaving only the water heating boilers in operation.
3. The entire hot water boiler installation shall be installed in accordance with manufacturer's installation specifications.
4. The "First-on-first-off" switch on the "S" control shall allow heating models to alternate firing sequence.
5. Boilers shall be as manufactured by Hydrotherm or equal.

3.25 EXAMINATION

A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started

B. The Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started

C. The Contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate — or if any discrepancies occur between the plans and the Contractor’s work, and the plans and the work of others — the Contractor shall report these discrepancies to the Engineer and shall obtain written instructions for any changes necessary to accommodate the Contractor’s work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the Contractor to report such discrepancies shall be made by — and at the expense of — this Contractor.

3.26 PROTECTION

A. The Contractor shall protect all work and material from damage by its work or employees, and shall be liable for all damage thus caused

B. The Contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted. The Contractor shall protect any material that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects

3.27 COORDINATION

A. Site

1. Where the mechanical work will be installed in close proximity to, or will interfere with work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. If the Contractor installs its work before coordinating with other trades, so as to cause any interference with

work of other trades, the Contractor shall make the necessary changes in its work to correct the condition without extra charge
2. Coordinate and schedule work with all other work in the same area, or with work which is dependent upon other work, to facilitate mutual progress.

B. Submittals. Refer to the "Submittals" Article in Part 1 of this specification for requirements

C. Test and Balance

1. The Contractor shall furnish all tools necessary to interface to the control system for test and balance purposes
2. The Contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours
3. In addition, the Contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.
4. The tools used during the test and balance process will be returned at the completion of the testing and balancing

D. Life Safety

1. Duct smoke detectors required for air handler shutdown are supplied and installed under Division 16. The Division 16 Contractor shall interlock smoke detectors to air handlers for shutdown as described in Part 3: "Sequences of Operation".
2. Smoke dampers and actuators required for duct smoke isolation are provided under another Division 15 Section
3. Fire/smoke dampers and actuators required for fire rated walls are provided under another Division 15 Section. Control of these dampers shall be by Division 16.

E. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the Contractor as follows:

1. All communication media and equipment shall be provided as specified in Part 2: "Communication" of this specification.
2. Each supplier of controls product is responsible for the configuration, programming, start-up, and testing of that product to meet the sequences of operation described in this section.
3. The Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this Section and those provided under other sections or divisions of this specification.

3.28 FIELD QUALITY CONTROL

A. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this specification

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship

C. Contractor shall have work inspected by local and/or state/provincial authorities having jurisdiction over the work

3.29 WIRING

A. All control and interlock wiring shall comply with national and local electrical codes and Division 16 of this specification. Where the requirements of this section differ with those in Division 16, the requirements of this section shall take precedence.

B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway per NEC and Division 16 requirement.

C. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)

3.30 ACTUATORS

A. Mount and link control damper actuators per manufacturer's instructions.To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.Provide all mounting hardware and linkages for actuator installation.

B. Electric/Electronic

1. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations
2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.31 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels, shall be labelled at each end within 5 cm [2"] of termination with the DDC address or termination number.

B. Permanently label or code each point/object of field terminal strips to show the instrument or item served.

C. Identify control panels with minimum 1 cm [½”] letters on laminated plastic nameplates.

D. Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.

E. Identify room sensors relating to terminal box or valves with nameplates.

3.32 CONTROLLERS

A. Provide a separate controller for each AHU or other HVAC system.

B. Building Controllers and Advanced Application Controllers shall be selected to provide a minimum of 15% spare I/O point/object capacity for each point/object type found at each location. If input /objects are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point/object used.

1. Future use of spare capacity shall require providing the field device, field wiring, point/object database definition, and custom software. No additional controller boards or point/object modules shall be required to implement use of these spare points

3.33 PROGRAMMING

A. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free for future use.

B. Point/object Naming: System point/object names shall be modular in design, allowing easy operator interface without the use of a written point/object index. Use the following naming convention:

AAABBBCCCDDDEEE where:

AAA is used to designate the location of the point/object within the building such as mechanical room, wing, or level, or the building itself in a multi-building environment.

BBB is used to designate the mechanical system with which the point/object is associated (e.g., A01, HTG, CLG, LTG).

CCC represents the equipment or material referenced (e.g., SAF for supply air fan , EXF for exhaust fan, RAF for return air fan).

D or DD or DDD may be used for clarification or for identification if more than one of CCC exists (e.g., SAF10, EXF121).

EE represents the action or state of the equipment or medium (e.g., T for temperature, RH for humidity, CO for control, S for status, D for damper control, I for current).

C. Software Programming

1. Provide programming for the system and adhere to the sequences of operation provided. The Contractor also shall provide all other system programming necessary for the operation of the system, but not specified in this document. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:
   a. Text-based:
      i. must provide actions for all possible situations
      ii. must be modular and structured
      iii. must be commented
   b. Graphic-based
      i. must provide actions for all possible situations
      ii. must be documented
   c. Parameter-based
      i. must provide actions for all possible situations
      ii. must be documented

D. Operator Interface

1. Standard Graphics. Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air

handler, and all terminal equipment. Point/object information on the graphic displays shall dynamically update. Show on each graphic all input and output points/objects for the system. Also show relevant calculated points/objects such as setpoints

2. Sow terminal equipment information on a "graphic" summary table. Provide dynamic information for each point/object show
3. The Contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all Operator Workstation software and their functions as described in this section. This includes any operating system software, the Operator Workstation database, and any third-party software installation and integration required for successful operation of the operator interface.

3.34 CONTROL SYSTEM CHECKOUT AND TESTING

A. Start-up Testing: All testing listed in this article shall be performed by the Contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Owner's Representative is notified of the system demonstration.

1. The Contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification
2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight
3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers' recommendations
4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct
5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The Contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Contractor shall make any necessary adjustments to valve stem and damper blade travel
6. Verify that the system operation adheres to the Sequences of Operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum Start/Stop routines.
7. Alarms and Interlocks
    a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm
    b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
    c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action

3.35 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration

1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed its own tests
2. The tests described in this section are to be performed in addition to the tests that the Contractor performs as a necessary part of the installation, startup, and debugging process and as specified in the "Control System Checkout and Testing" Article in Part 3 of this specification. The Engineer will be present to observe and review these tests. The Engineer shall be notified at least 10 days in advance of the start of the testing procedures.
3. The demonstration process shall follow that approved in Part 1: "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration
4. The Contractor shall provide at least two persons equipped with two-way communication, and shall demonstrate actual field operation of each control and sensing point for all modes of

operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point/object and system. Any test equipment required to prove the proper operation shall be provided by and operated by the Contractor.

5. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
6. Demonstrate compliance with Part 1: “System Performance
7. Demonstrate compliance with Sequences of Operation through all modes of operation
8. Demonstrate complete operation of Operator Workstation
9. Additionally, the following items shall be demonstrated:

    a. DDC Loop Response. The Contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in setpoint, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the setpoint, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.
    b. Demand limiting. The Contractor shall supply a trend data output showing the action of the demand-limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting setpoint, and the status of shed-able equipment outputs.
    c. Optimum Start/Stop. The Contractor shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas
    d. Interface to the building fire alarm system
    e. Operational logs for each system that indicate all setpoints, operating points, valve positions, mode, and equipment status shall be submitted to the Architect/Engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.
    f. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The Contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

B. Acceptance

1. All tests described in this specification shall have been performed to the satisfaction of both the Engineer and Owner prior to the acceptance of the control system as meeting the requirements of Completion. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Engineer. Such tests shall then be performed as part of the warranty.
2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1: “Submittals.”

3.36 CLEANING

A. The Contractor shall clean up all debris resulting from its activities daily. The Contractor shall remove all cartons, containers, crates, etc., under its control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

B.

B. At the completion of work in any area, the Contractor shall clean all of its work, equipment, etc., keeping it free from dust, dirt, and debris, etc.

C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.37 TRAINING

A. General

1. Provide a minimum of one onsite training class 8 hours in length during the construction period for personnel designated by the owner.
2. Provide two additional training sessions at 6 and 12 months following building's turnover. Each session shall be 8 hrs in length and must be coordinated with the building Owner.

B. Train the designated staff of Owner's Representative and Owner to enable Day-to-day Operators to:

1. Proficiently operate the system.
2. Understand control system architecture and configuration.
3. Understand DDC system components.
4. Understand system operation, including DDC system control and optimizing routines (algorithms).
5. Operate the workstation and peripherals.
6. Log on and off the system.
7. Access graphics, point/object reports, and logs.
8. Adjust and change system setpoints, time schedules, and holiday schedules.
9. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
10. Understand system drawings, and Operation and Maintenance manual.
11. Understand the job layout and location of control components.
12. Access data from DDC controllers and ASC.
13. Operate portable operator's terminals.

C. Train the designated staff of Owner's Representative and Owner to enable Advanced Operators to:

1. Make and change graphics on the workstation
2. Create, delete, and modify alarms, including annunciation and routing of these
3. Create, delete, and modify point/object trend logs, and graph or print these
4. Create, delete, and modify reports
5. Add, remove, and modify system's physical points/objects
6. Create, modify, and delete programming
7. Add panels when required
8. Add Operator Workstation stations
9. Create, delete, and modify system displays — both graphical and otherwise

10. Perform DDC system field checkout procedures
11. Perform DDC controller unit operation and maintenance procedures
12. Perform workstation and peripheral operation and maintenance procedures
13. Perform DDC system diagnostic procedures
14. Configure hardware including PC boards, switches, communication, and I/O points/objects
15. Maintain, calibrate, troubleshoot, diagnose, and repair hardware
16. Adjust, calibrate, and replace system components

D. Train the designated staff of Owner's Representative and Owner to enable System Managers/Administrators to:

1. Maintain software and prepare backups
2. Interface with job-specific, third-party operator software
3. Add new users and understand password security procedures

E. Provide course outline and materials as per "Submittals" Article in Part 1 of this specification. The instructor(s) shall provide one copy of training material per student.

C.

F. The instructor(s) shall be factory-trained instructors experienced in presenting this material.

G. Classroom training shall be done using a network of working controllers representative of the installed hardware.

3.38 EXECUTION

A. Verify that door frame and adjacent construction are installed and ready to receive work of this Section.

B. Verify that utilities are in correct location and are of correct capacities for specified products.

3.39 INSTALLATION

A. Install air doors where shown on Drawings and in accordance with [shop drawings and] manufacturers instructions.

B. Air doors shall be securely installed plumb, level, and as close as practical to top of opening and face of wall.

C. Install switches where indicated.

D. Connection to utilities is specified in RELATED WORK.

3.40 SYSTEM STARTUP

A. Test and operate air door to be sure that it performs as intended. Adjust discharge nozzles to deflect air outward [unless otherwise required.]

4.1 AUTOMATIC TEMPERATURE CONTROL SYSTEM

D. Approved Control System Manufacturer

1. The base bid is based on Johnson Controls or equal. Other manufacturers shall bid subject to meeting all requirements of the specification.

E. COMMUNICATION

1. All control products provided for this project shall comprise a BACnet internetwork. Communication involving control components (i.e., all types of controllers and Operator Workstations) shall conform to ANSI/ASHRAE Standard 135-2001, BACnet.
2. Each BACnet device shall operate on the BACnet Data Link/Physical layer protocol specified for that device as defined in this section.
3. The Contractor shall provide all communication media, connectors, repeaters, bridges, hubs, switches, and routers necessary for the internetwork.
4. All controllers shall have a communication port for connections with the Operator Workstations using the BACnet Data Link or equal Physical layer protocol.
5. A device on the internetwork shall be provided with a 56k-baud modem that will allow for remote Operator Workstation using the BACnet PTP Data Link/ Physical layer protocol. Remote Operator Workstation via this modem shall allow for communication with any and all controllers on this network as described in Paragraph F below.
6. Communication services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:
   a. Connection of an Operator Workstation device to any one controller on the internetwork will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the internetwork.
   b. All database values (e.g., objects, software variables, custom program variables) of any one controller shall be readable by any other controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to an object name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communication services to perform internetwork value passing.
7. The time clocks in all controllers shall be automatically synchronized daily. An operator change to the time clock in any controller shall be automatically broadcast to all controllers on the network.
8. The network shall have the following minimum capacity for future expansion:
   a. Each Building Controller shall have routing capacity for 99 controllers.
   b. The Building Controller network shall have capacity for 1000 Building Controllers.
   c. The system shall have an overall capacity for 12,500 Building Controller, Advanced Application Controller, and Application Specific Controller input/output objects.

SECTION 16000
ELECTRICAL

PART 1.00 – GENERAL

1.01 GENERAL PROVISIONS

A. Applicable provisions of "General Conditions" govern work under this section.
B. The Electrical Contractor shall review all other sections of these Specifications for requirements therein affecting the work of this Section.
C. The Electrical Contractor shall conform to all sections of these Specifications and Drawings.
D. Contractors duties for work specified below shall include compliance with all Codes, Ordinances, Rules, Regulations, Orders and all other requirements of Authorities which bear on performance of work.

1.02 SCOPE OF WORK

A. Furnish all labor, supervision, permits, certificates, materials, equipment, apparatus, accessories, supplies, tools, transportation and services necessary for and incidental to, all electrical work as shown on the Drawings and/or specified hereinafter to the full completion of installation and operation of the electrical system.
B. The principal items of work are as follows;

1. Temporary Service
2. Primary Service and Primary cables
3. Pad mounted transformer
4. Secondary Service
5. Voice / Data Service
6. Grounding
7. Main Service Switchboard
8. Power and lighting panels
9. Lighting fixtures and lamps
10. Lighting Controls
11. Safety switches
12. Feeders to panels
13. Branch circuit wiring
14. Outlet boxes, receptacles, etc.
15. Fire Alarm System
16. Emergency Lighting System
17. Emergency Generator and Automatic Transfer Switches
18. All wiring for heating ventilating equipment, wherever required as indicated on Drawings, except control wiring and motor starters
19. Tel/Data outlets and wiring
20. Access Control
21. Site Lighting
22. Lightning Protection System
23. All other systems, equipment and work hereinafter specified and/or shown on the Contract Drawings.

C. It is the intent of the Specifications and the accompanying Drawings that the systems shall be furnished and installed complete. The Electrical Contractor shall furnish and install all conduit, wire, boxes, equipment, devices and controls needed and usually furnished in connection with such work, whether specifically mentioned or not.
D. The Specifications and the accompanying Drawings are complimentary to one another and if a conflict arises between the specifications and drawings and/or within the drawings themselves the contractor shall provide the worst case scenario.
E. This Contractor shall refer to the Architectural, Structural, Plumbing, Mechanical and Fire Protection Drawings and all other Drawings associated with the project,

prior to the installation or roughing of the electrical outlets, conduit and equipment to determine the exact location of all outlets.

1.03 WORK NOT INCLUDED

A. The following items of labor and material incidental and/or related to the installation of the electrical work will be provided and/or installed under other sections of the Specification.

1. All cutting, patching and furring.
2. Painting of all equipment and material other than factory finished.
3. Flashing
4. Excavation and backfill.
5. Concrete work.

1.04 DEFINITIONS

A. The "Electrical Contractor" specifically means, the Contractor working under this section for the specifications.

B. "Furnish and install" or "provide" means to supply, erect, install and connect up complete, in readiness for regular operation, the particular work referred to unless otherwise specified.

C. "Piping" includes, in addition to pipe, all fittings, boxes, hangers and other accessories relating to such piping.

D. "Concealed" means hidden from sight, in chases, furred spaces, shafts, hung ceilings and embedded in construction.

E. "Exposed" means visible in sight, not installed "concealed" as defined above.

F. "Approved Equal" means any equipment or material which is equal in quality, durability, appearance, strength, design and performance to the equipment or material specified and which will function adequately in accordance with the general design and is approved by the engineer.

1.05 CODES AND STANDARDS

A. Unless otherwise specified or indicated, materials and workmanship shall conform to the latest edition of the following Standards, Codes, specifications, Requirements and Regulations.

1. National Electrical Code
2. State Electrical code
3. National Electrical Contractors Association.
4. National Electrical Manufacturer's Association
5. Underwriters' Laboratories, Inc.
6. National Fire Protection Association
7. Local Wiring Inspector
8. Local Fire Marshall
9. State Fire Marshall
10. International Building Code
11. International Energy Conservation Code
12. All other State and Local Codes and/or Authorities having jurisdiction, including any and all other paragraphs of this Specification.

1.06 PERMITS AND FEES

A. The Electrical Contractor shall secure and pay for all required permits.

B. The Electrical Contractor shall carry in his bid price and pay all costs incurred for, standard to be performed in conjunction with this Contract that are necessary for and incidental to, the accomplishment of his work and the use of work when completed.

C. The Electrical Contractor shall, after completion, furnish to the General Contractor a Certificate of Final Inspection and Approval from the Local Electrical Inspection Department.

1.07 MATERIALS AND WORKMANSHIP

A. Materials and workmanship shall be the best of their respective kinds and in full accordance with the most modern construction methods.

B. Electrical materials and equipment of types for which there are Underwriters' Laboratories standard requirements, listings or labels, shall conform to their requirements and be so labeled.

1.08 TESTS

A. The right is reserved to conduct acceptance tests of all equipment, wiring or any other work furnished under these Drawings and/or Specifications to determine the fulfillment of specific requirements and/or design.

B. The Electrical Contractor shall conduct all such tests in the presence of authorized representatives of the Owner and at such times that the Owner may designate.

C. The Electrical Contractor shall perform all tests, supply all instrumentation, personnel and make all adjustments of equipment and wiring as may be necessary.

1.09 PORTABLE OR DETACHABLE PARTS

A. The Electrical Contractor shall retain in his possession and shall be responsible for, all portable and/or detachable parts and portions of the installation, including fuses, keys, locks, adapters, blocking clips, inserts, lamp instruction, drawings and all other devices or materials that are relative to and necessary for the proper operation and maintenance of the electrical system until final completion of his work.

1.10 PROTECTION AND CLEANING OF EQUIPMENT

A. All electrical equipment, upon receipt, shall be adequately stored and protected from damage.

B. After inspection, all electrical equipment shall be protected to prevent damage during the construction period. Openings in all conduits, raceways, fittings and boxes shall be closed to prevent entrance of foreign materials.

C. Before completion of work and before final inspection, all damaged and/or defective equipment and material shall be replaced and all exposed surfaces of electrical equipment shall be clean.

1.11 DRAWINGS AND SPECIFICATIONS

A. The Drawings and these Specifications are complimentary to each other and any labor or material called for by either, whether or not by both, necessary for the successful operation of any of the particular types of equipment furnished under this Contract, shall be furnished and installed.

B. Where a conflict arises between the drawings and specifications and/or within the drawings themselves the electrical contractor shall provide the worst case scenario.

C. Before installing any of the electrical work, see that it does not interfere with the clearances required for existing finished columns, pilasters, partitions, or walls. Installed work, which interferes with other trades, shall be changed as directed by the Owner's representatives.

1.12 OBTAINING INFORMATION

A. Obtain detailed information from the manufacturers of apparatus, which he is to furnish and install as to the proper method of installing and connecting same. Obtain all required information from the Owner's representative and other Subcontractors necessary to facilitate and complete the electrical work. Check all other Contract Drawings and all other sections of Contract Specifications for electrical equipment requiring connections and electrical characteristics of equipment should they differ from the Electrical Drawings.

1.13 SAFETY PRECAUTIONS

A. The Electrical Contractor shall furnish, place and maintain power guards and other necessary construction, required for the prevention of accidents to secure safety of life and/or property.

1.14 REMOVAL OF RUBBISH

A. After completion of the work, the Electrical Contractor shall remove all waste, rubbish and other materials left as a result of his operations and leave the premises in clean condition.

B. In addition to the cleaning up required in the Special Provisions, the Electrical Contractor shall, at the completion of the work, clean, polish, and/or wash all exposed items or materials, equipment and fixtures in this Contact, so as to leave such items bright and clean.

C. The Electrical Contractor shall repaint any painted metal surfaces, which have been scratched, dented, or marred.

1.15 COORDINATION OF TRADES

A. The Electrical Contractor shall give full cooperation to other trades and shall furnish (in writing, with copies to Engineers) any information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.

B. Where the work of the Electrical Contractor will be installed in close proximity to work of other trades or where there is evidence that this Contractor will interfere with the work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. All cutting and patching, excavation and backfill shall be done by the General Contractor. The Contractor shall inform the General Contractor well in advance as to his requirements.

C. This contractor shall be responsible for coordinating with all the dental equipment vendors to ensure that all power, data, control and lighting requirements are met throughout the building. Before any conduit or cable is run the electrical contractor shall coordinate with the appropriate dental vendor exact location of conduit entries to the various pieces of equipment. The electrical contractor shall coordinate all voltage and outlet configurations.

1.16 VISITING THE SITE

A. The Electrical Contractor shall be required to visit the site and examine the existing conditions, which may affect his work under this Contract.

B. The electrical contractor shall be responsible to “make-safe” all the existing structures in preparation for demolition. This contractor shall be responsible for coordinating with Central Maine Power Company before any power, telephone, fire alarm service, etc. are terminated.

1.17 FIELD MEASUREMENTS

A. The Electrical Contractor shall verify in the field all measurements necessary for his work and shall assume responsibility for their accuracy.

1.18 GUARANTEE

A. The Electrical Contractor guarantees by his acceptance of the Contract that all work installed will be free from any and all defects in workmanship and/or materials during period of one (1) year from date of Certificates of Completion and acceptance of work. If any such defects in workmanship or material appear, he will, without cost to the Owner, remedy such defects within a reasonable time.

1.19 SHOP DRAWINGS AND SAMPLES

A. Before ordering material shipped to the job, the Electrical Contractor shall submit to the General Contractor for approval manufacturers references and bulletins, Shop Drawings, in sextuplet, giving all details, dimensions, etc. of the following;

1. Primary cables (if applicable and approved by the utility company)
2. Primary transformer (if applicable and approved by the utility company)
3. Manholes/handholes
4. Light and Power panels
5. Main Service equipment
6. All lighting fixtures, lamps and ballasts
7. Lighting Controls (all components)
8. Time Controllers
9. Disconnect switches
10. Fire Alarm equipment
11. Emergency Lighting System components
12. Emergency Generator and Automatic Transfer Switches
13. Wiring Devices (each type)
14. Wiring (each type)
15. Tel/data, equipment, wiring devices, wire, patch panels, racks, ect.
16. Lightning Protection equipment and wiring
17. Security equipment, if applicable

B. Should the Electrical Contractor choose to substitute for the specified equipment, the Shop drawing submittals must include catalog cuts of originally specified equipment. Shop Drawings submitted for approval without all of the required information will not be considered for approval.

1.20 SUPERINTENDENCE OF WORK

A. The Electrical Contractor shall give his personal superintendence to the work and shall retain at the job site during the period of construction, a competent Foreman, satisfactory to the Contractor, who shall be in full charge of the work under this section.

1.21 STORAGE OF MATERIALS

A. The Electrical Contractor shall store his material and equipment before installation only where designated by the General Contractor. He shall be responsible for all his property stored on the premises and shall hold the General Contractor free form liability for loss by theft or carelessness of employees of the General contractor or of other Sub-Contractors. The Electrical Contractor shall take particular care to protect any finished work for injury or defacement and must remedy, at his expense, any injury cased thereto by his operations.

1.22 RECORD DRAWINGS

A. The Electrical Contractor shall maintain at the site a set of black line prints on which shall be accurately shown the actual installation of work under this section, indicating therein and variation, approved by the General contractor, from the Contract Drawings, including changes in sizes, locations and dimensions at the conclusion of the work, the Electrical Contractor shall deliver to the General Contractor for submittal to the Owner, a complete set of reproducible Record Drawings showing the entire work as actually installed and two (2) sets of black or blue line on white prints.

1.23 CONTRACT DRAWINGS

A. The Contract Drawings are generally diagrammatic and are intended to convey the scope of work and indicate general arrangements of equipment, conduits, piping and fixtures.
B. If directed by the General Contractor, the Electrical Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

1.24 TEMPORARY SERVICE

A. Furnish and erect a suitable backboard for temporary meters and switches to measure and control current for testing, wiring, motors and other appliances; for temporary lighting, machines or the apparatus used in the construction of the building, until such time as the permanent meter is installed. Furnish and mount on this temporary board, an approved type of service switch and do all necessary wiring to connect such circuits as required.
B. Special heavy-duty circuits shall be paid for by the trade requiring same.
C. Obtain city-wiring permit for the temporary wiring and pay all fees for same.

PART 2.00 – PRODUCTS

2.01 RIGID STEEL CONDUIT

A. All rigid steel conduit shall have a hot-dipped galvanized coat plus a secondary coat, galvanized threads, bear an Underwriters' Laboratories label and shall conform to Federal Specifications WW-C-581d and American Standards Association Specification C80.1. The conduit shall be fully threaded at both ends and each length shall be furnished with one standard threaded coupling. The use of threadless conduit couplings and fittings will not be permitted. Threaded split couplings of the bolted clamp type are permitted. Rigid steel conduit shall be used for all power wiring where indicated.
B. Galvanized rigid steel conduit sweeps and quarter bends shall be installed at the utility company transformer and at the utility company poles. Each sweep to a pole shall extend ten feet up the pole with galvanized rigid steel conduit.
C. Galvanized rigid steel conduit shall be installed were conduit needs to pass under roadways.

2.02 ELECTRICAL METALLIC TUBING

A. Electrical metallic tubing shall be Electro-galvanized outside and enameled inside. All electrical metallic tubing shall bear an Underwriters' Laboratories label and shall conform to Federal Specifications WW-C-563 and American Standards Association Specification C80-3.
B. Couplings and fittings for EMT shall be of the compression type or set screw type. EMT shall not be installed embedded in concrete, outdoors or in wet locations.
C. Any exposed wiring within the facility shall be installed in Electrical Metallic Tubing.
D. Conduit sleeves shall be installed at all floors for voice/data network connectivity. Sleeves shall be fire rated to maintain the integrity of the floor assembly.

2.03 FLEXIBLE METALLIC CONDUIT

A. Flexible metal conduit shall be galvanized steel, and shall contain an integral copper grounding conductor. Liquid-tight flexible metal conduit shall be similar, but shall also have an extruded moisture and oil-proof outer jacket of polyvinyl chloride plastic.

B. Flexible metal conduit shall be utilized on all vibrating electrical equipment and shall be no greater than three feet in length.
C. Liquid-tight flexible conduit shall be utilized on final connections to any outdoor equipment.

2.04 PVC CONDUIT

A. Plastic conduit shall be PVC Schedule 40, iron pipe size, rigid polyvinylchloride equal to or better than ASTM Pipe Material ASTM PVC conduit Type 2, Grade 1, ASTM PVC 2110, Specification P-1785, Underwriters' Laboratory, Inc. approved for lengths beyond ten (10) feet shall be identical to the approved conduit. Where elbows are used, they shall be long radius type. PVC Conduit shall be manufactured by Kraloy, Barrett Division of Allied Chemical, Pittsburgh; Triangle Cable and Conduit Co., or approved equal.
B. Schedule 40 PVC conduits shall be installed, directly buried in earth as indicated on the drawings.
C. PVC conduits shall come in 10'-0" lengths and multiple lengths are coupled together they shall be connected with a coupling and PVC glue.
D. PVC Glue by Gorilla shall be non-flammable, low odor with no harmful fumes. The glue shall be fast acting to adhere to conduits and couplings and shall meet or exceed NSF, ASTM D-2564, IAPMO and R &T standards. The glue shall not require any primer require only the use of water for any spills or clean up.
E. Conduits shall be installed as indicated on the drawings and all empty conduits shall be supplied with a ¼" nylon pull string. The pull string shall run the entire length of each conduit with at least 24 inches of slack at each end.
F. All conduits entering or leaving a transformer, hand hole, manhole or any other enclosure shall be done with 22.5 degree sweeps and each sweep shall be provided with bell ends.

2.05 WIREWAYS

A. Totally enclosed sheet steel wireways, complete with all fittings, tees, elbows, wire retainers, closure plates, hangers, and component parts required for a complete installation shall be installed in all areas indicated on the Drawings and as required to facilitate the installation of the electrical systems.
B. Physical size, length, and internal cross sectional areas, of the wireways shall be determined in the field by the Electrical Subcontractor to suit field conditions unless noted otherwise on the Drawings.
C. The wireway systems shall be constructed of code gauge galvanized sheet steel with hinged cover. Straight sections of the wireway system shall be constructed of two separate pieces of sheet steel. One piece shall be used to form the sides and top, the other to form the cover. Captive screws, furnished as a part of the wireway system, shall be used for sealing at all hinged covers and coupling at straight sections or fittings.
D. All fittings, elbows, tees, and straight sections of the wireway shall be provided with smooth and round edges to protect the wiring from abrasion. All welded seams and joints shall be ground and polished to remove burred edges.
E. A bonding jumper consisting of an insulated flexible #8 AWG copper conductor with soldered eyelet on each end shall be provided to bound and ground the wireway at each joining section of the wireway system. The bonding jumpers shall be attached to each section by means of a bolt, locknut, and washer. The Electrical Subcontractor shall remove the paint from the wireway at the contact points so that positive contact shall be made between the bare metals at each grounding point.
F. The wireway system shall be provided with ½ inch and ¾ inch concentric knockouts every 6 inches on center along the top and ½ inch, ¾ inch, 1 inch, and 1-1/4 inches concentric knockouts every 6 inches along both sides.

G. All sheet metal posts shall be factory primed with rust inhibiting phosphor coating and finished with USASI #24 dark gray enamel. All hardware shall be cadmium-plated to prevent rusting and corrosion.

H. All lengths, connectors, and fittings of the wireway systems shall be UL approved and bear the Underwriters' Laboratories label. UL listing of lengths without listing of connectors and associated components or fittings shall not be acceptable.

I. The wireway system, all component parts and fittings, shall be by one manufacturer and shall be manufactured by Kelek, Lee Products, Keystone or equal.

2.06 OUTLET, PULL AND JUNCTION BOXES

A. The locations of all wall switch boxes shall be coordinated with the Drawings and Project Manager before installation of same. All switch boxes unless specifically noted otherwise on the Drawings shall be opposite the hinged side of the door for all single doors.

B. The location of outlets shown on Drawings are approximate. The Electrical Contractor shall study the building plans in relation to the spaces and equipment surrounding each outlet, so that receptacles, switches, lighting fixtures, devices, or other electrical components are symmetrically located and mounted in or on the walls, ceiling, and floor.

C. Outlet, junction or pull boxes, shown on the Drawings, that interfere with the installation of mechanical equipment, structural or architectural features, or that will be inaccessible due to the work of other trades shall be relocated accordingly.

D. Outlet, junction or pull boxes that are not specifically shown on the Drawings but are required for the proper installation of the electrical system shall be installed by the Electrical Contractor, so that they do not interfere with the structural or architectural features and the installation of materials by the other trades.

E. Any reasonable change in the location of outlets, pull or junction boxes requested by the Architect, prior to roughing, shall not involve additional expense to the Owner.

F. All outlet, pull and junction boxes shall be installed in a rigid and satisfactory manner and shall be supported by bar hangers in frame constructions or shall be fastened directly with wood screws on wood, bolts with expansion shields on concrete or brick, toggle bolts on hollow masonry units and machine screws or welded threaded studs on metal. Threaded studs of the proper type and holding capacity driven in by a powder charge and provided with lock washers and nuts are acceptable for mounting of boxes on solid concrete walls or slabs. Preset inserts of the proper type and holding capacity shall be used in overhead slab construction wherever possible for the support of pull and junction boxes.

G. Feeders passing through pull or junction boxes shall be individually grouped and bound with tie-raps. The feeders in each pull or junction box shall be properly tagged to clearly indicate their electrical characteristics, circuit number and panel designation. Cables shall be supported on suitable racks within the boxes and arranged in an orderly manner.

H. Flush mounted ceiling and wall outlet boxes shall be provided with the proper type extension rings, tile and plaster collars required to set flush with the finished surfaces of the ceiling or walls.

I. Outlet boxes shall, in general, be as follows:

1. Exposed, surface and pendant mounted outlet boxes or outlet boxes installed in normally wet locations shall be of the cast metal type with threaded hubs as manufactured by Crouse-Hinds, Appleton, Red Dot, or Russell and Stoll.
2. Recessed outlet boxes for non-hazardous locations shall be of the pressed sheet steel, zinc coated, cadmium plated type.
3. Outlet boxes shall not be less than 1-1/2 inches deep unless shallower boxes are required by structural conditions and are specifically approved by the Architect.
4. Ceiling and bracket outlet boxes shall not be less than 4 inch octagonal, except that smaller boxes may be used where required by the particular fixture to be

installed. Flush or recessed fixture shall be provided with separate outlet boxes where required by the future terminal temperature requirements.

5. Outlet boxes for general use, flush mounted in concrete work and walls in non-hazardous and normally dry locations, shall be manufactured by Steel City, Appleton, Raco or equal.

J. Pull and junction boxes shall, in general, be as follows:

1. Pull and junction boxes shall be constructed of code gauge galvanized sheet metal, of not less than minimum size required by the N.E.C. or other applicable Specification "STANDARDS" and shall be furnished with securely fastened covers. Boxes exceeding 48 inches in any direction shall be properly reinforced with angle iron stiffeners.
2. Pull and junction boxes of other than standard manufacturer's trade size shall be manufactured by Keystone, Lee Products or Empire.
3. Standard trade size pull and junction boxes shall be produced by the manufacturers listed above as applicable.
4. Pull and junction boxes to be installed in normally wet location areas shall be of the cast type with threaded hub and gasketed coverplate. The cast pull and junction boxes shall be manufactured by O.Z., Crouse-Hinds, Appleton or equal.

K. Outlet, pull, and junction boxes shall be properly sealed during the course of construction to prevent the entrance of dirt and foreign materials within same or the raceway system of which it is a part. The Electrical Contractor shall provide temporary covers for all open boxes. Paper may be solidly packed into standard work boxes to prevent the entrance of dirt and foreign materials, in lieu of coverplates if so elected by the Electrical Contractor.

2.07 AIR VAPOR BARRIER BOX

A. Electrical contractor shall provide air-vapor barrier boxes at outlet boxes installed within any vapor barrier to provide airtight construction around all the outlets.

B. The air-vapor barrier boxes shall be made of rigid polyethylene with a hinge feature to allow easy installation of any standard electrical outlet box.

C. The air-vapor barrier boxes shall be installed by the electrical contractor and sealed by the air sealing contractor.

D. The air-vapor barrier boxes shall be designed and installed to protect the seal made around the wires that enter or leave the box.

E. The air-vapor barrier box shall allow for inspection and verification of a complete seal with air vapor barrier material before the wall is closed. This shall be coordinated in the field with the air sealing contractor.

2.08 FIRE STOPPING

A. Electrical contractor shall provide Intumescent fire stopping all around each conduit that penetrates a rated wall, floor and/or ceiling. Fire stop putty shall all 10% movement and be water-based intumescent acrylate and have a shelf life of 12 months. The fire stopping shall be skin forming within 15 minutes and have an application temperature from 5 degrees C to 40 degrees C. Fire stopping shall be manufactured by Hilti.

B. Fire stop putty pads shall be installed around outlet boxes that are located on party walls and/or fire rated walls or ceiling assemblies. Putty pads shall be intumescent, non-conductive, synthetic rubber and free from asbestos. The putty pads shall have an application temperature from 5 degrees C to 35 degrees C and a reaction temperature of 140 degrees C with a shelf life of 24 months. Putty pads shall be FM and UL 263 approved and manufactured by Hilti.

2.09 METAL CLAD CABLE

A. All conductor wires and cables for secondary circuits shall consist of thoroughly tinned 98 percent conductivity copper, with 600 volt nylon-covered (75 degrees C)

insulation with an interlocked galvanized steel armor, insulated bushings, manufactured in strict accordance with the requirements of the Board of Underwriters' and the A.I.E.E..

B. Wires, #10/2 w/GRD., #12/2 w/GRD., and #14/2 w/GRD., Metal Clad cable, type "MC", shall be type "THHN" solid, unless otherwise noted or shown on plans; sizes #6 AWG and larger shall be stranded Type "THHN".

C. No wire smaller than 12/2 w/GRD. metal clad cable shall be used for any branch circuit. Larger sizes shall be used where so indicated on the plans.

D. All wire shall be color-coded.

E. Type MC cable shall not be used in concrete, direct buried in earth or where exposed to chemical vapors.

F. Type MC cable can be used as panel feeders, branch circuits, run exposed, run concealed, in raceway, as open runs above ceilings, etc.

G. Type MC cable shall be secured by insulated staples, cable-ties, straps and/or hangers at intervals not to exceed 6'-0' on center and within 12" of every cabinet, box or fitting.

H. In addition to the line and neutral conductors, all Metal Clad cable shall be equipped with a full size, green insulated ground conductor that runs the entire length of every branch circuit. Type "AC" shall not be permitted.

2.10 WIRES AND CABLES

A. Unless otherwise specified, all wires and cables shall be thoroughly tinned 98% conductivity copper, single conductor type "THHN" moisture and heat resistant polyvinylchloride thermoplastic for use at 600 volts A.C. and D.C., rated 60 degrees C. operating temperature. Wires and cables #6 AWG and larger shall be type "THHN", unless noted otherwise. The wires and cable shall have the Underwriters' Laboratories, Inc. label and be surface printed throughout the entire length at two-foot intervals with permanent identifying markings indicating manufacturer's name, size, type, and voltage. All wire and cable shall be furnished on reels or spools and in lengths required to minimize splicing.

B. Fixture wiring for use on 250 volts A.C. shall be type XFF, cross linked, polyfin insulated, #14 AWG, 300 volts.

C. Branch circuit wire in continuous raceways shall be type "THHN", heat resistant, nylon covered thermoplastic.

D. Wires of #12, and #10 AWG shall be solid or stranded, #8 AWG and larger shall be stranded.

E. Wires and cables #2 AWG and smaller shall be of continuous solid colors follows:

1. SYSTEM VOLTAGES: 120/208 3 PH., 4 WIRE

Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Equip.Grd.	Green

2. All wires larger than #2 AWG shall be color-tape coded at all terminations.

2.11 LIGHTING FIXTURES

A. The Contractor shall furnish and install the lighting fixtures, complete for each and every light outlet in the type quality, and size of fixture indicated on the Plans and in the Fixture Schedule, unless called for specifically to be omitted herein. It shall be the responsibility of this Contractor to check the Plans with the Schedule for completeness. No substitutes will be accepted.

B. This Contractor shall include all fixture wiring, hanging, uncrating, connecting up and making ready for operation. All fixture wire for fixtures shall not be less than #16 gauge, but larger if capacity of fixture requires it, and finished with asbestos-covered wires where exposed to excessive heat.

C. This Contractor shall include the cost of furnishing and installing all lamps for all fixtures under this Contract throughout. All lamps for all fixtures shall be furnished in types as indicated. All lamps for Rapid-Start fixtures shall be General Electric, Westinghouse, or Sylvania, as called for under each fixture type.

D. The Contractor shall check structural and architectural details of all locations where fixtures are to be installed so that he can properly provide for installation of the fixtures.

2.12 LIGHT SWITCHES (Commercial Spec. Grade)

A. All local wall switches shall be of the flush Quiet style, single pole, double pole, three-way or four-way, as required and as manufactured by Pass & Seymour / Legrand.

B. All switches shall be suitable for the control of tungsten filament lamps, fluorescent loads and shall carry the proper marking of the Underwriters' Laboratories.

C. Switches shall be equal to the following Pass & Seymour / Legrand devices:

Single-pole PS2621
Three-way PS2623
120 Volt Fluorescent Dimmer PS934821

D. Color of devices shall be selected by the architect.

2.13 OCCUPANCY SENSORS

A. The electrical contractor shall furnish and install a wall mounted, dual technology, passive infrared (PIR) and ultrasonic occupancy sensor as indicated on the drawings. Each occupancy sensor shall turn lights on when PIR and ultrasonic technologies detect occupancy.

B. The PIR technology shall sense the difference between infrared energy from a human body in motion and the background space. The ultrasonic technology shall utilize the Doppler Principle and high frequency (40kHZ) ultrasound to sense motion within each space.

C. Once the lighting is "on" either technology will hold the lights "on". When no occupancy is detected for the length of the pre-determined time delay, the lights turn "off".

D. Each occupancy sensor shall be able to be set so that only one of the technologies is needed to turn lights "on" or both technologies can hold the light "on".

E. Each occupancy sensor shall be 24 volt DC/AC equipped with an isolated relay with Normally Open and Normally Closed contacts rated for 1 amp @ 24 volts DC/AC

F. Each occupancy sensor shall have built-in time delays as follows; automatic, fixed (5, 10, 15, 20 or 30 minutes), walk through and test mode.

G. Each occupancy sensor shall have Sensitivity adjustments as follows; Smart Set (automatic) or reduced sensitivity (for PIR sensitivity); ultrasonic sensitivity is variable with built-in trimpot.

H. Each occupancy sensor shall be equipped with a 2-200 footcandle light level sensor and shall have a low voltage momentary switch input for manual operation.

I. Sensors shall be capable of multi-sensor application to allow for zone control.

J. Each occupancy sensor shall work with a power pack be UL and CUL listed and come with a five year factory warranty.

2.14 LIGHT SAVER POWER PACKS

A. The electrical contractor shall furnish and install a light saver power pack with each dimming controller. The power pack will be DIN rail mounted in the same 8" x 8" x 4" NEMA I enclosure mentioned above.

B. Each power pack shall multi-voltage (120/230/277 volt) on the primary side and 24 volts on the secondary side.

C. Each power pack shall provide 1000 ma for three (3) normally open 620 va relays @ 120 volts.
D. Each power pack shall connect to it respective dimming controller via RJ12 quick connect jack and cable that will be furnished with each power pack.
E. Each power pack shall have integral fuse protection and a Green power LED light.
F. Each power pack shall be UL and CUL listed and come with a five year factory warranty.
G. Each power pack shall be manufactured by Watt Stopper #BT-203.

2.15 DIMMING CONTROLLER/ POWER PACK ENCLOSURE

A. The electrical contractor shall furnish and install a NEMA I (8" x 8" x 4") electrical enclosure above the ceiling in each classroom.
B. Each enclosure shall be suitable for indoor, dry location use and come with a single, pre-mounted DIN rail and screw cover.
C. Each DIN rail shall be capable of holding a single dimming controller and a single power.
D. Each enclosure shall be manufactured by Watt Stopper #LS-E8.

2.16 DAY LIGHT (PHOTO) SENSORS

A. The electrical contractor shall furnish and install a ceiling mounted photosensers as indicated on the drawings. Each photosensor shall provide daylight data necessary for the operation of each dimming control system.
B. Each photosensor shall have the ability to continuously measure ambient light levels from incoming daylight from the window walls while differentiating from electrical light.
C. Each photsensor shall have three (3) selectable footcandle ranges from 3-300 fc; 30-300 fc and 60-600 fc.
D. Each photosensor shall be a low voltage, Class 2 device and wired with a 3 conductor #22 AWG, plenum rated twisted cable equal to Belden #8443.
E. Each photosensor shall be UL and CUL listed and come with a five year factory warranty.
F. Each photosensor shall be manufactured by Watt Stopper #LS-290C

2.17 RECEPTACLES (Commercial Spec. Grade)

A. All convenience outlets shall be of the single or duplex type, back or side wired, T-slot and polarized slot type. All receptacles shall be of the grounded type and be rated 20-amp as indicated. Receptacles shall be manufactured by Pass & Seymour / Legrand or Hubbell and shall be Plug Tail Style.
B. Receptacles must feature a solid brass strap with integral ground break-off ears, brass auto ground clip crimped to the strap, wrap around face locking strap and locking drive screws and wide body design.
C. All receptacles must be finger safe with built-in brass terminals to accept plug tail connector with solid or stranded #12 awg conductors, including the ground conductor. The connector shall have large brass contacts with an audible snapping latch to assure connection and allow release.
D. All receptacles must be finger safe with no exposed terminals after installation and shall have circuit identification in the label on the face of each receptacle.
E. Exposed molded parts of the receptacles must be constructed of high impact-resistant nylon or polycarbonate and must match the faceplates.
F. In general, convenience outlet circuits shall be independent of light circuits and shall not be controlled by light circuit switches or light switches, unless specifically shown.
G. All twenty-amp circuits indicated on the drawings shall be wired to twenty amp devices. The use of a fifteen amp rated receptacle on a twenty-amp circuit is not acceptable.

H. Standard duplex receptacles specified shall be used for dual circuited receptacles by removal of break-off shunt.

I. Exterior receptacles and/or receptacles in wet locations shall be provided with an "in-use" cover in accordance with Article 406 of the National Electrical Code. Covers shall be polycarbonate construction with a watershed channel, cord flap gasket, 1" profile and have the ability of being installed without removing a device through the use of keyed mounting holes. In-use covers shall be manufactured by Pass & Seymour/Legrand # WIUC10-SC or Hubbell.

J. All wiring devices throughout each Patient Care area shall be hospital grade devices in accordance with Article 517 of the National Electric Code.

K. All wiring devices throughout the facility shall be provided with a circuit directory on its respective face that is comprised of the panel designation power originates from along with the exact branch circuit number. (ie, LP1A-10)

L. All receptacles installed throughout the building complex shall be as follows, or equal to:

1. Duplex convenience receptacles 20A, 125V, single phase, 3 wire U-slot grounded type shall be Pass & Seymour / Legrand #PT8300/PT6STR or Hubbell.
2. Duplex 20A, feed thru, 125V, single phase, 3-wire, U-slot ground fault interrupting convenience receptacle shall be Pass & Seymour / Legrand #2094-I or Hubbell.
3. Hospital Grade convenience receptacles shall be 20A, 125 V., singles phase, 3 wire, U-slot, grounded type with a Green LED illuminated face. Pass & Seymour / Legrand #PT8300ILI or Hubbell.
4. Exact NEMA configuration of all special purpose outlets shall be coordinated in the field with the equipment manufacturer and/or the General Contractor.

2.18 MISCELLANEOUS GENERAL PURPOSE DEVICES

A. All other special and general-purpose receptacles called for on the Drawings shall be of the same grade as indicated above, ivory phenolic compound finish and manufactured by Leviton, Hubbell, P&S or equal.

2.19 DEVICE PLATES

A. All plates used on switch and plug receptacles in finished spaces where wiring is concealed, shall be non-metallic type. Plates on exposed conduits to be sherardized. Non-metallic type shall be ivory color to match devices.

B. Gang plates shall be used where multiple switches and/or receptacles occur at one location.

C. Plates shall be of the same manufacturer as the wiring devices or equal.

2.20 FLUORESCENT BALLASTS

A. All fluorescent ballasts as indicated shall be of the electronic type and their design and construction shall conform to the CBM Standards certified by ETL.

B. The ballast fill material shall be of thermosetting type and shall not soften under failure. The ballasts shall be equipped with an internal automatic resetting thermal protector adjacent to the coils. The ballast case temperature shall not exceed 90 degrees C in continuous operation.

C. Fluorescent ballast's shall be electronic type with full light output as manufactured by Advance Ballast Company or approved equal.

D. Ballast's shall be Instant Start, Class P and shall be in accordance with the schedule set forth by the National Electrical Code.

E. Compact Fluorescent ballasts shall be One-Lamp, Encapsulated, Electronic type. Ballasts shall be Class P with sound rating A and Automatic Resetting feature. Compact Fluorescent ballast's shall be as manufactured by Advanced Ballast Company or approved equal.

F. Compact Fluorescent Dimming ballast's shall be One-Lamp, Encapsulated, Electronic type at full light output. Dimming Ballast's shall be Class P with sound

rating A and Automatic Resetting feature. Dimming Ballast's shall be capable of dimming down to 20 percent of the rated lumen output using a standard U.L. listed incandescent dimmer switch. Compact Fluorescent Dimming ballast's shall be manufactured by Advance Transformer Company, Energy Saving Ballast's Company or approved equal.

2.21 LIGHTING CONTROL SYSTEM

A. The Electrical Sub-Contractor, as part of the work of this section, shall coordinate, receive, mount, connect and place into operation the lighting control panels indicated on the drawings. The system and all of its components shall be manufactured by Gentec or equal. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for the complete and properly functioning lighting control system as described herein and shown on the plans.

B. Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, a qualified factory representative shall completely check the installation prior to energizing the system. At the time of checkout and testing, the User Agency's representative shall be thoroughly instructed in the proper operation to the system.

C. Manufacturer's products shall be listed by Underwriters Laboratories, Inc. (U.L.) and comply with the National Electrical Code (NEC) and local building codes that apply.

D. The equipment specified herein shall be the coordinated product of a single manufacturer. All controls and cabinet fabrication must take place in the manufacturer's plant. The use of subcontracted component assemblers is not acceptable.

E. The manufacturer shall be one who has been continuously engaged in the manufacture of lighting controls for a minimum of ten years.

F. All equipment shall be 100% tested as a complete system. Manufacturers using sample testing methods are not acceptable.

G. All equipment shall be warranted free of defects in materials and workmanship for a period of one year from date of turn-on.

H. System Testing

1. All relays shall be assembled into the cabinets and all interwiring completed at the factory prior to shipment. All relays shall be simultaneously connected to their respective loads, all control stations shall be connected to the cabinet (or cabinets) and testing shall be done as a complete system under power at the factory prior to shipment. This testing shall include exercising all functions such as take control, transferring, mastering, or other special control provisions, and this shall be done for each individual control and control station included in this system. Control system shipped as components for job site assembly or that are not completely tested as a system at the factory prior to shipping shall not be acceptable. Sample testing methods are not acceptable.

I. Equipment

1. The switching control system shall be a modular design and shall occupy the same space in the enclosure as other relay modules, photo sensors and time switches, thereby allowing complete interchange ability between system components.
2. Lighting control panels shall be as indicated on the drawings. The control panels shall be complete with 20 amp relays rated 277 volts, a time clock with astronomical functions that automatically adjust to day light savings and seasonal changes, photocell capability and remote momentary switches capable of controlling groups of relays and/or a single relay. The panel shall have the number of channels as indicated on the drawings and shall be

easily programmable in the field. Programming instructions shall be embossed on the inside of the door to the unit and when more than one panel is indicated the panels shall be capable of be linked together through a data loop. The lighting control panels shall be Gentec or equal.

3. Two integrated contact closure inputs for interface with occupant sensors and day light sensors shall be provided.
4. The panels shall be capable of providing digital control for up to 30 circuits per panel.
5. The circuits and channels shall be the capable of being programmed to be controlled independently or as part of a scene.
6. Four button momentary switches shall be a part of the installation. The exact quantity and location of the switches shall be as indicated on the drawings.

J. Installation

1. It shall be the responsibility of the Electrical Contractor to receive and store the necessary materials and equipment for the control system. It is the intent of these specifications and plans to include everything required for proper and complete installation and operation of the lighting control, even though every item may not be specifically mentioned. The contractor shall timely deliver to other trades any equipment that must be installed during construction.
2. The Electrical Contractor shall be responsible for field measurements and coordinating the physical size of all equipment with the architectural requirements of the spaces into which they are to be installed.
3. The Electrical Contractor shall install all lighting control equipment in accordance with manufacturer's shop drawings.
4. All branch load circuits shall be live tested by the Electrical Contractor before connecting the loads to any of the relay module load terminals.

K. Manufacturer's Services

1. Upon completion of the installation including testing of load circuits, the contractor shall notify the system manufacturer that the system is available for formal checkout. This notification is to be given in writing two weeks prior to the time factory trained personnel are needed on the job site. At the manufacturer's discretion, formal turn-on can be waived. No power is to be applied to the system unless specifically authorized by written instructions from the manufacturer.

2.22 LIGHTING CONTACTORS

A. Lighting contactors shall be suitable for ballasted lamps and filament at 480 volts maximum.
B. The lighting contactors shall be 12 poles and mechanically held and designed to handle the switching of tungsten or ballasted lamps as well as other non-motor loads.
C. The contactors shall be designed to withstand the large initial inrush currents of tungsten and ballast lamp loads as well as non-motor (resistive) loads without contact welding
D. The contactors shall be rated 30 amperes per pole.
E. The contactors shall have an interlock that removes the power from the pickup coil and shall require application of power to release the contactor to the OFF position
F. The contactors shall be capable of operating such that it will not switch to OFF during power failure to the control circuit
G. The contactor shall be installed in a NEMA 1 enclosure

H. Mechanically-held contactors shall be Eaton / Cutler-Hammer type C30CN for 30 ampere rating.

I. 30 ampere rated contactor shall have finger safe terminals and normally open and normally closed poles shall be interchangeable where the installation of the pole on the contactor base determines if the pole is normally open or normally closed and not the pole itself. Contactor shall be field configurable from electrically held to mechanically held.

2.23 A.C. PANELBOARDS

A. Panelboards and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA and UL as follows: UL 67 – Panelboards, UL 50 – Cabinets and boxes, NEMA PB1, Fed. Spec. W-P-115C and Circuit breaker – Type I class I.

B. The convertible distribution and lighting circuit breaker panelboards shall be the dead-front type with door and door construction and shall be in accordance with the Underwriters' Laboratories, Inc. "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled.

1. All cabinets shall be made of code gauge steel or better and if painted shall be undercoated with a rustproof bonderized surface or galvanized and treated with a non-acid agent prior to painting. Fronts, provided with doors, shall be cold-rolled sheet steel with gray finish. Directory frames shall be included on the backs of all doors. All locks shall be keyed alike. Fronts shall be furnished with approved adjustable trim clamps and means shall be provided for entrance to gutter space, lugs, etc.
2. Circuit breakers shall be 1" per pole and be of the bolt-on type, stab types will not be permitted, indicating "ON-OFF" "TRIPPED" positions of the operating handle. When the breaker is tripped automatically, the handle shall assume a middle position between an overload on one pole shall automatically cause all poles to open. Two or more single pole breakers with one handle extension will not be permitted. The circuit breakers shall be quick-break on manual, as well as automatic operation and shall have inverse time characteristics secured through the use of a bi-metallic tripping element supplemented by a magnetic trip. Circuit breaker arc quenching shall be equal to or better than the "De-Ion" arc extinguishing principle.
3. All panelboard assemblies shall be factory assembled complete with circuit breakers as shown on the Contract Plans. Interiors shall be so designed and assembled that any individual breaker can be replaced without disturbing adjacent units or without removing main bus or branch circuit connectors. All bussing shall be copper. Main bus bars and back pans of distribution and power panelboards shall be of such design that branch circuits may be changed without additional machining, drilling, or tapping. Where copper contact surfaces are furnished on main and branch circuit connectors, the copper shall have a 1,000 amperes/square inch density and contact surfaces of not more than 200 amperes per square inch. Silver Plated contacts which meet the same values are acceptable. Lighting and power branch circuit panelboards shall be so designed that the branch circuit connections to the main bus provide sequence (fully distributed) phasing, and such connections shall be clearly and permanently identified on the face of the front of the panel interior.

C. A.C. Power Distribution Panels shall be convertible circuit breaker distribution Panelboards as manufactured by Cutler Hammer or General Electric.

D. Frame size for each breaker shall be as shown on the Contract Plans. All bussing shall be copper. The bare, solid, copper neutral bus shall be electrically insulated from the panel and a separate, bare copper grounding bus shall be provided in each panel. Copper ground bus shall be the equivalent of the solid neutral bus. Buses shall be clearly identified.

E. A.C. Lighting Panels shall be circuit breaker Panelboards as manufactured by Cutler Hammer or General Electric. Frame size for each breaker shall be as shown on the Contract Plans. All bussing shall be copper. The bare solid copper neutral bus shall be electrically insulated from the panel and a separate, bare copper grounding bus shall be provided in each panel. Copper grounding bus shall be the equivalent size of the solid, neutral bus. Buses shall be clearly identified.

F. Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts.

G. Doors shall have a semi flush cylinder lock and catch assembly. Doors over 48 inches in height shall have auxiliary fasteners.

A directory card with a clear plastic cover shall be supplied and mounted on the inside of each door. All locks shall be keyed alike.

2.24 SAFETY SWITCHES AND FUSES

A. Safety switches shall be of the fusible or non-fusible type as indicated on Drawings equipped with an external lever or handle for manual operation. Each unit shall be enclosed in a code-cage, sheet steel cabinet suitable for surface mounting as indicated on the drawings. Surface mounted units shall have hinged door and catches. Neutral conductors shall be solid throughout. Weatherproof switches shall be of the NEMA 3R type.

B. Safety switches shall be heavy duty type as manufactured by Square D Company, General Electric Company, Westinghouse, or I.T.E.

C. Furnish and install a complete set of fuses for installation and deliver to the Owner one set of spare fuses. Fuses shall be as manufactured by Chase Shawmut, Bussman, or Littlefuse/Tracor.

2.25 GENERAL PANEL INFORMATION

A. All panels shall be properly balanced, the circuit numbers on the Plans being a numerical indication rather than any attempt to indicate proper balance.

B. Care shall be taken in the use of a common neutral to make certain that no more than one leg is taken from each phase.

C. Typed indexes shall be provided in each panel indicating circuit number and the outlets or items controlled or fed from same.

2.26 MAIN DISTRIBUTION EQUIPMENT

A. Furnish and install the service entrance switchboard as herein specified and shown on the associated electrical drawings. The switchboard shall meet all the requirements set forth by Underwriters' Laboratories and shall be listed and labeled.

B. The switchboard framework shall be fabricated on a die-formed base or base assembly consisting of formed steel and commercial channel welded or bolted together to rigidly support the entire shipping unit for moving on rollers for mounting. The framework is to be formed code gauge steel, rigidly welded and bolted together to support all cover plates, bussing, and component devices during shipment installation. Each switchboard section shall have an open bottom and individual removable top plate for installation and termination of conduit. Top and bottom conduit area is to be clearly shown and dimensioned on the Shop Drawings. The wireway front covers are to be hinged to permit access to the branch breaker load side terminals without removing the covers. All closure plates shall be screw removable and small enough for easy handling by one man. The paint finish shall be gray enamel over a rust-inhibiting phosphate primer.

C. The switchboard bussing shall be plated copper and of sufficient cross-sectional area to continuously conduct rated full load current with a maximum average temperature rise of 65 degrees C. above an ambient temperature of 40 degrees C. The bus bars shall be rigidly braced to comply with the integrated equipment rating of the switchboard. The horizontal bus bars between sections shall be located on the back

of the switchboard to permit a maximum of available conduit area. The end section is to have bus bar provisions for future addition of a switchboard section. The provisions shall include the bus bars installed to the extreme side of the switchboard and prepunched to facilitate future bolted splice plates. The horizontal main bus bar supports, connections, and joints are to be bolted with grade 5 carriage bolts and Belleville washers to be free of required periodic maintenance. The switchboard shall be bus sized and metered as shown on the Drawings.

D. The switchboard, as a complete unit, shall be given a single integrated equipment rating to meet the available fault current as coordinated with the local utility company or a minimum of 65,000 amperes symmetrical fault current or larger as recommended by the manufacturer. The switchboard manufacturer shall certify that all equipment is capable of withstanding the stresses of a fault equal to that of the fault current mentioned above at lowest rated overcurrent protective device contained therein. Certification shall be established by factory tests done by the manufacturer on similar equipment. This test data shall be available and shall be furnished to the Engineer, if requested, with or before the submittal of approval Drawings.

E. The main circuit breakers shall have the capability of being 100% rated and meet all the requirements specified below.

F. Each low-voltage power circuit breaker and insulated case circuit breaker shall be equipped with a solid-state tripping system consisting of three current sensors, microprocessor-based trip device and flux-transfer shunt trip. Current sensors shall provide operation and signal function. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached. Interchangeable current sensors with their associated rating plug shall establish the continuous trip rating of each circuit breaker. The trip unit shall be Eaton type Digitrip RMS 520MC.

G. The trip unit shall have an information system that provides LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip.

H. The trip unit shall be provided with a display panel, including a representation of the time/current curve that will indicate the protection functions. The unit shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.

I. The trip unit shall be provided with a making-current release circuit. The circuit shall be armed for approximately two cycles after breaker closing and shall operate for all peak fault levels above 25 times the ampere value of the rating plug.

J. Trip unit shall have selectable thermal memory for enhanced circuit protection.

K. Protective device coordination shall be provided by the addition of the following individually adjustable time/current curve shaping solid-state elements: All circuit breakers shall have adjustments for long delay pickup and time. Main and Feeder Breakers shall have individual adjustments for short delay pickup and time, and include I^2t settings.

L. Main and Feeder breakers shall have an adjustable instantaneous pickup

M. All circuit breakers shall have individually adjustable ground fault current pickup and time, and include I^2t settings or ground alarm only

N. The trip unit shall have provisions for a single test kit to test each of the trip functions.

O. The trip unit shall provide zone interlocking for the short-time delay and ground fault delay trip functions for improved system coordination. The zone interlocking

system shall restrain the tripping of an upstream breaker and allow the breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after a preset time delay. Factory shall wire for zone interlocking for the power circuit breakers within the switchgear.

P. The trip unit shall have an information system that utilizes battery backup LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A test pushbutton shall energize a LED to indicate the battery status.

Q. All circuit breakers shall have individually adjustable ground fault alarm only.

R. The trip unit shall have a 4-character LCD display showing phase, neutral, and ground current. The accuracy of these readings shall be +/- 2% of full scale.

S. The trip unit shall be equipped to permit communication via a network twisted pair to the LAN system provided in the equipment for remote monitoring and control. All monitored parameters shall be transmitted.

T. The trip unit shall be provided with an Arcflash Reduction Maintenance System Technology capability. The Arcflash Reduction Maintenance System shall allow the operator to enable a maintenance mode using a 5 position switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. A blue LED on the trip unit shall indicate the trip unit is in the maintenance mode.

U. Distribution circuit breakers shall be 80 percent rated, group mounted with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Each breaker shall have a circuit cardholder and neatly printed card identifying the circuit. Tripped indication shall be clearly shown by the breaker handle taking a position between ON and OFF. The entire switchboard shall be manufactured by Eaton/Cutler Hammer or General Electric.

V. Distribution circuit breakers shall electronic trip type with instantaneous, long and short delay, ground fault and arc-flash protection. These circuit breakers shall have true RMS sensing for increased reliability. Each circuit breaker shall have an Ir switch to eliminate the need for rating plugs, Long Delay setting (I2t) setting with variable times, Long, Short, Instantaneous and Ground Fault protection and zone selective interlock from 15-amps to 2500-amps.

W. Each circuit breaker shall have an arc-flash reduction maintenance system along with a High Load alarm, Ground Fault alarm and Cause of Trip indication.

X. The mains switchboard section shall be equipped with a panel mounted digital ammeter, volt meter, power consumption meter, and cause of trip LED indicator.

Y. The switchboard shall be provided with bussed pull section rated at 2,500-amps and is a minimum of 36” wide. The bus bars in the pull section shall carry the rating to the switchboard sections mentioned above.

Z. Each molded case circuit breaker microprocessor-based tripping system shall consist of three (3) current sensors, a trip unit and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors, and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached. The trip unit shall be Eaton type 0, Digitrip 310+ or approved equal.

AA. An adjustable trip setting dial mounted on the front of the trip unit, or interchangeable ratings plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be fixed or adjustable as indicated. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.

BB. System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:

CC. Adjustable long-time setting (set by adjusting the trip setting dial or rating plug)

DD. Adjustable short-time setting and delay with selective curve shaping

EE. Adjustable instantaneous setting

FF. Adjustable ground fault setting and delay

GG. The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.

HH. When the adjustable instantaneous setting is omitted, the trip unit shall be provided with an instantaneous override.

II. Where internal ground fault protection is specified, adjustable settings shall not exceed 1200 amperes. Provide neutral ground fault sensor for four-wire loads.

JJ. Breakers shall have built-in test points for testing the long-time delay, instantaneous, and ground fault functions of the breaker by means of a test set. Provide one test set capable of testing all breakers 225-ampere frame and above.

KK. Provide an ammeter display, Eaton DigiView or approved equal. The metering module shall display load current, and after a fault shall indicate the cause of trip.

LL. Trip units shall include zone interlocking capability for the short-time delay and ground fault delay trip functions for improved system coordination. The zone interlocking system shall restrain the tripping of an upstream circuit breaker and allow the circuit breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after the pre-set time delay. Factory wire zone interlocking system for breakers within each assembly.

MM. 20% spare circuit breaker shall be installed within each switchboard section. Each spare circuit breaker frame shall be 200-amps minimum.

NN. The electrical contractor shall be responsible for a complete coordination study to properly set all adjustable settings on circuit breakers. A copy of the coordination study shall be submitted to the engineer and the owner as part of the as-built drawings.

OO. The switchboard and all panelboards shall be manufactured by the same manufacturer. The switchboard and panelboards shall be manufactured by Eaton Cutlet/Hammer.

PP. The utility metering configuration shall be coordinated with a representative from the local utility company.

2.27 MOTOR WIRING

A. The Contractor shall do all wiring required for plumbing, ventilating and heating motors including mounting of switches and starters, as well as wiring of same. All wiring for the control of motors unless indicated on Electrical Plan, shall be provided under HVAC, Plumbing and Fire Protection.

B. The Contractor shall furnish and install horsepower rated disconnecting means as required by the National Electrical Code for all motors. Motor-driven equipment specified under “Plumbing” and “Heating and Ventilating” may be factory wired complete with controller and motor disconnects; the Contractor shall coordinate equipment purchased under these divisions so as to provide any necessary equipment. Motor disconnects shall be unfused unless noted otherwise. Single-phase motor disconnects may be a thermal switch.

C. Each disconnect shall be clearly labeled with a screw fastened ¼” engraved nameplate stating load controlled.

2.28 MOTOR STARTERS AND CONTROLS

A. Motors will be furnished and installed under the respective Sections of the Specifications under which the equipment is specified.
B. Motors ½ hp and larger will be 3 phase, 60 Hertz; motors less than ½ hp will be 120 volts, single, 60 Hertz, except specifically noted equipment.
C. All motor starters and controls unless furnished as an integral part of the equipment, shall be provided with suitable metal enclosures and shall conform to the NEMA Industrial Control Standards.
D. All motor starters shall have individual running overcurrent protection in each phase and shall be provided with two sets of auxiliary contacts. Starters for single phase motors shall be 2-pole and for 3 phase motors shall be 3-pole.
E. Manual starters shall be of the toggle mechanism type for full voltage starting. Magnetic starters shall be across-the-line type, minimum size NEMA 1 equipped with Hand-Off-Automatic switch.
F. Each motor starter and each control station shall be clearly labeled with screw fastened ¼" engraved nameplate stating equipment controlled.
G. All motor starters shall be furnished by the mechanical contractor.

2.29 PRIMARY DISTRIBUTION SYSTEM

A. Furnish and install all conduit, as indicated on the Drawings. Excavation, backfilling, and concrete work for duct banks and manholes shall be furnished under another Section of the Specification.
B. Underground conduit encased in concrete shall be Schedule 40 Polyvinyl Chloride (PVC) conduit, or approved equal, unless otherwise noted on Drawings. Where PVC conduit is connected to galvanized rigid steel conduit, approved adapters shall be utilized.
C. Conduits shall be secured in duct bank with approved spacers and fastening methods to assure no movement during concrete pour.
D. All Power, Telephone/Data and Cable Television manholes indicated on the drawings shall be constructed of pre-cast concrete with grounding terminal and pig tails for connecting to ground rods.
E. Primary cable shall be 15KV rated, 1/0 aluminum, 1330% rated with a fully jacketed concentric neutral as manufactured by Okonite Cable.
F. Primary load break elbows shall be 15KV, 200-amp rated as manufactured by Cooper or equal.

2.30 SECONDARY ELECTRICAL SERVICE

A. Secondary electrical service shall commence at a secondary connection of the pad mounted transformer. Primary and Secondary connections shall be the responsibility of this contractor unless otherwise indicated by the local utility company.
B. Electrical Contractor shall furnish and install conduit, wire, compression connectors from the secondary spades at transformer to main circuit breaker in the main switchboard. Sizes of which shall be indicated on the Drawings.
C. Electrical Contractor shall furnish and install a concrete envelope around the secondary conduits as indicated on the drawings. The primary and secondary duct bank assembly shall be buried a minimum of 36 inches below the finished grade and each duct bank section shall have a yellow warning tape run the entire length of the respective duct bank. Backfill in trenches shall be select material with no stone or rock larger than a ½" in diameter.

2.31 NAMEPLATES

A. Nameplates shall be furnished and installed on all panelboards, pull boxes, cabinets, for all special purpose switches, motor disconnect switches, remote control stations, motor starters and other controls furnished under this Contract, to designate the equipment controlled and function. Nameplates shall be laminated black bakelite

with ¼ inch high white recessed letters. Nameplates shall be securely attached to the equipment with galvanized screws or rivets.

2.32 SUPPLEMENTARY STEEL, CHANNEL, AND SUPPORTS

A. The Electrical Contractor shall furnish and install all supplementary steel, channels, and supports required for the proper installation, mounting and support of all lighting fixtures and electrical equipment, to be installed under this Contract, as required.

B. All supplementary steel, channels, and supports shall be furnished, installed, and secured with all fittings, support rods, and appurtenances required for a complete support mounting system.

C. The type and size of the supporting channels and supplementary steel shall be determined by the Electrical Contractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with requirement for loading.

D. All supplementary steel and channels shall be installed in the neat and workmanship manner parallel to the walls, floor, and ceiling construction. All turns shall be made with 90 degree and 45 degree fittings, as required to suit the construction and installation conditions.

2.33 VOICE/DATA UNDERGROUND CONDUIT SYSTEM

A. Furnish and install all conduits as indicated on the Drawings. Excavation and backfilling shall be furnished under another section of this Specification. The voice/data duct bank assembly shall be buried a minimum of 36 inches below the finished grade and shall have a yellow warning tape run the entire length. Backfill in trenches shall be select material with no stone or rock larger than a ½" in diameter.

B. Lay conduits in trenches in true alignment and sloped for drainage. All conduits shall slope away from the building.

C. Materials: Schedule 40 PVC conduit as manufactured by Carlon, in 10' lengths, including all couplings and appurtenances necessary for laying in complete conduit line.

2.34 VOICE/DATA SYSTEM

A. Voice over Internet Protocol (VoIP) digital phone service will be utilized as part of this building fit-out. The system shall have the capability of making regular telephone calls over a broadband high speed internet telephone service.

B. VoIP and data service shall originate from the adjacent buildings tel/data closet as indicated on the drawings. The electrical contractor shall coordinate with the staff IT representative, the exact quantity and type of fiber optic cables and copper back bone cables shall be brought to the new facility.

C. Backboards for VoIP equipment shall be furnished and installed by the General Contractor. Main backboard shall be as dimensioned on the Plans. All backboards shall be painted black on both sides with fire resistant paint.

D. The electrical subcontractor shall be responsible for extending the voice/data services to the satellite electric closets as indicated on the drawings.

E. The electrical subcontractor shall furnish and install the service conduit that feeds the building.

F. All backboards shall be furnished with a ground bar with an insulated stand-off secured to the backboard. A #6 bare copper ground conductor shall be bolted to the ground bar with a two hole high compression connector on one end of the cable and the other end of the cable shall be connected to a piece of bare building steel with an approved connector. The ground bar shall be capable of handling at least 12 subordinate connections

G. The electrical subcontractor shall furnish and install all equipment to the Main Backboard. The Electrical Contractor shall furnish all conduit and sleeves where required. The Electrical Contractor shall furnish and install all VoIP outlets and all wiring indicated below.

H. VoIP system wiring and devices shall be as follows:

1. VoIP wiring shall originate from outlets indicated on the drawings and homerun to the either the main backboard or a satellite electric closet as indicated. Wiring for single VoIP outlets shall consist of CAT6 for Data (Blue Colored Cable) and CAT6 for (White Colored Cable and Blue Colored Cable) for dula port outlets. Cables shall terminate at a flush mounted, single or dual port modular RJ-45 jacks. Exact jack type shall conform to the requirements as indicated on the drawings. Cables shall be UL CM rated, meet U.L. 444 and NEC article 800.
2. The electrical contractor shall furnish separate and distinct 48-port patch panels for the single and dual port cables as indicated on the drawings. Exact quantity of patch panels shall be determined by the contractor.

2.35 ACCESS CONTROL SYSTEM

A. Provide Access Control and Alarm Monitoring System as specified herein. All Proximity Readers and alarm points in the building shall be monitored at the main office computer head end.
B. The system shall consist of a multi-drop RS-485 communication with the master controller located in the main tel/data room. A single twisted pair of #24 AWG (Beldon 9501) can be used up to 16,000 feet to connect slave controllers.
C. Each exterior door shall be provided with access control and monitoring as described below.
D. Provide complete contract maintenance service through a factory approved (i.e., factory supervised, trained and equipped) local service shop. Such service shall include: Routine preventative maintenance and periodic checks on equipment performance.
E. Provide dual reader controllers that can support all major reader technologies and 12-digit ABA card formats.
F. Controllers shall utilize “distributed” database technology for independent operation.
G. Controllers shall operate in local or remote site configuration and dial-up or leased line.
H. 750 users and 250 events.
I. Expandable to 8 doors on 2 ports
J. 4 alarm inputs, 4 relay outputs (DPDT)
K. 64 Time zones control card access, Relays, and Alarm Points.
L. Relays are “Time-Programmable” for automatic control.
M. Relays are form “C” contacts rated at 24VDC, 3 Volt/Amps.
N. Anti-passback feature
O. Controllers shall be Keri Systems PXL-510 Tiger II w/18vac, 40va transformer, S-4 Suppressor, and battery backup or approved equal. Provide Keri SB-593 Satellite Interface Expansion Board.
P. Pro series readers use an advanced signal processing technique to communicate with proximity cards.
Q. All proximity readers shall operate on low power consumption for extended reader operation.
R. Card readers shall be designed to provide protection from reader tampering.
S. All card readers shall be rated for Indoor/Outdoor use and protect from harsh environments.
T. The card readers shall operate from a range of 12” from reader face or as shown on drawings.
U. Card Readers shall be Keri PSM-2 or approved equal.
V. Provide wall, doorframe, or ceiling mounted exit PIR’s at each door.
W. Provide a PIR unit with built-in sounder for door position monitoring.
X. PIR shall have dual relay outputs.
Y. PIR shall have an adjustable range.
Z. PIR shall be provided with an attractive housing.
AA. PIR shall be tied to the access control controllers.
BB. PIR shall have a separate relay to monitor the door contact for door position.

CC. PIR shall have 4 programmable latch times from 5 to 120 seconds.
DD. PIR External over drive input to allow a remote pushbutton to unlock doors.
EE. PIR shall be Sentrol RTE-1000 or approved equal.
FF. Provide surface wide gap contacts at each door indicated.
GG. Contacts shall have mounting brackets shall be provided with each unit.
HH. Contacts shall be SPDT version.
II. Provide armored cable leads with each unit set of contacts.
JJ. Contacts shall be Sentrol 25O7AH or approved equal
KK. Exterior Siren/Beacon

1. Indoor/Outdoor self-contained armored siren/strobe combination.
2. 122dB sound output
3. 15 Watt armored siren
4. Warble sound output
5. Rust –free aluminum die-cast housing
6. 60,000 candle power strobe
7. Dual-action reed tamper switch
8. Polarized 12VDC input with reverse polarity protection

Provide Amseco SSX-51SB Siren/Strobe or approved equal

LL. Supply all conduit, wire, etc. required for installation and needed to provide a completed, usable security system to the extent such items are not detailed elsewhere in the drawings and the specification.
MM. Contractor shall coordinate final location of all equipment with the Architect and Owner prior to installation.

2.36 CCTV SYSTEM

A. Security camera's shall terminate to a 16 channel, I Terabyte hard drive, Digital Video Recorder (DVR), with wavejet compression technology, together with other related equipment, rack mounted preferably in the Tel/data closet. The DVR shall be manufactured by General Electric #DVMRE-10CTII-600GB.
B. Cameras shall be fixed in place or pan-tilt zoom type and shall be flush mounted inside or outside the building in a variety of locations as indicated on the drawings at a minimum at each exterior door location.
C. Cameras shall be wired with coaxial cable and in all cases be Belden B649948 Siamese RG 59 w/ 2 conductor #18 awg or equivalent.
D. All camera's shall be color and have high resolution sensor and digital signal processing, wide dynamic range sensor, low light sensors that are sensitive to 0.01 lux and can be used in infrared lighting. The cameras shall have backlight compensation and wide dynamic range, auto tracking and multiple mounting options.
E. Each camera shall be equipped with standard C and CS mount lens. Each lens shall be auto iris to open wider and let more light in under low-light conditions. In bright light it reduces so the picture remains sharp.
F. Each camera shall have dual video inputs, variable high speed electronic shutter and side mounted controls.
G. Each camera shall be an ultra-view dome camera with exposure technology and equipped with auto iris, 3 to 8 millimeter lens. Each camera shall be mounted to a flush mount adapter kit. Camera and mounting kit shall be manufactured by General Electric #DI-XP2-VFA3/KTA-FM-38.
H. All camera housings shall be heavy-duty and weather resistant. Domes shall be polycarbonate with tamper proof screws.
I. Cameras shall display images on a High Resolution (500 TV Lines), microprocessor based, 17" color LCD monitor located adjacent to the DVR. The monitor shall be manufactured by General Electric #KCL-17HS.

J. Power supply for the camera system shall be 120-volt input /12/24 power limited output with integral battery back-up. The power supply shall be manufactured by Altronix #AL400ULX.

K. All exterior doors shall be equipped with exterior Pan-Tilt-Zoom cameras and all interior corridors and stairs shall be equipped with a fixed interior dome type camera.

2.37 ADDRESSABLE/ANALOG FIRE ALARM SYSTEM

A. General Requirements:
   1. Comply with Division1, General Requirements and documents referred to therein.
   2. Provide all labor, equipment, and materials to complete the Life Safety Fire Alarm System work in accordance with local and State Regulations.
   3. Fire alarm system and components shall be listed to U.L. standard 864, 9th Edition and Manufactured by Gamewell Company.

B. Description of System:
   1. The Life Safety Fire Alarm System shall be an addressable, non-coded, electronically supervised, microprocessor based, voice evacuation system. It shall be complete with all necessary hardware, software and memory specifically tailored for this installation. It shall be possible to permanently modify the software on site by using an integral service console or with a personal computer and specific system software.
   2. The fire alarm control panel shall be installed in the main lobby. New addressable Signaling Line Circuits (SLC) will emanate from this panel to all the floors and new initiating devices as indicated on the drawings.
   3. Provide smoke and fire detection, sprinkler supervision, and automated single stage evacuation control. Interface to environmental controls and auxiliary devices.
   4. Provide signal appliances and signal controls for the safe and orderly evacuation of the building.
   5. The Life Safety System shall generally consist of the following main components:
      a. control panel with 24/10 batteries
      b. addressable devices
      c. supervisory relays for sprinkler devices, etc.
      d. auxiliary devices for door holders, access control, etc.
      e. audio/visual devices
      f. LCD type annunciator
      g. framed graphic plan
      h. exterior beacon
      i. exterior sprinkler bell
      j. bi-directional antenna
      k. emergency generator run light
   6. Locate the main components and all related devices in the main lobby as shown on the Plans.

C. Bi-Directional Antenna (BDA) system
   1. This contractor shall be responsible for coordinating with the Fire Department a radio test that shall determine the signal reception at several locations on each floor. Clear signal strength shall be required throughout the building utilizing the type of hand held radio unit used by the local fire department. Quantity of test locations shall be determined and conducted by a fire department representative. The minimum test points shall be determined by the following equation; (floor square footage / 25,000 sq.ft.) x 2. Additional specific test points may need to be considered in areas containing special wall construction or a large quantity of electromechanical building system equipment.

2. Signal strength testing shall follow TXB-88 standards using Delivered Audio Quality (DAQ) measurements.
3. A minimum signal strength of -95dBm (DAQ4) shall be available over 95% of each floor area requiring coverage when transmitted from the fire department.
4. A minimum signal strength of -95dBm (DAQ4) shall be received at the fire department system from over 95% of each floor area requiring coverage.
5. Frequency ranges shall be determined by the local fire department.
6. BDA shall be Amp - TXRX Model 61-89-50-A18, UHF 80dB, 806-869 Bi-directional signal amplifier or approved equal.
7. The amplifier shall be housed in NEMA 4 Weatherproof housing colored fire engine red and marked "Newton Fire Dept. Radio"
8. Above housing shall include a Locking Cabinet keyed alike with the other fire alarm devices and cabinets.
9. Amplifier shall be complete with DC Power Revert and back up battery & charger
10. TrippLite BP260; TrippLite 98-121; SC-49 Smart Charger
11. Trilogy AT012R50 Riser Rated ½" 50 Ohm Coaxial cable shall be utilized for risers and Trilogy AQ012J50 Plenum Rated ½" 50 Ohm Radiating Coaxial cable for horizontal runs on each floor.
12. Cable connectors shall consist of Trilogy Male/Female connector kits NMP01250 & NFP01250
13. Comprod 362-75 806-960MHz Multi Band Antenna
14. Maxrad MYA8066 800MHz Yagi Antenna
15. The system manufacturer shall provide a wiring diagram and shop drawings of the exact system being proposed prior to any equipment being purchased. All equipment and wiring methods shall be approved by the local fire department and the engineer.
16. Prior to the system being accepted, the contractor shall submit certification that the system is compatible with the local fire department radio system and field tests have been conducted to the satisfaction of the local fire department.

D. Automatic Alarm Operations:

1. Operation of an addressable alarm input device shall flash the alarm signal, and annunciate on the alphanumeric LCD 80-character display. Display the type, condition, and a location message for the first alarm immediately without the need for operator response. Capture the display to annunciate an alarm. In the event the shared display is annunciating when events of a lower priority or the FACP is in the site-programming mode. Turn on a red alarm LED at the control panel.
2. Sort new (subsequent) events by type and log into queues for display by emergency user selection. Sound a momentary audible signal for each event occurrence. Flash a queue LED when an unseen event exists in a queue. Update the display to annunciate the total by type and the chronological number of the event on display i.e. 3 alarm reports - #2 displayed.
3. Activate the new transponder.
4. Sound the evacuation signals throughout the building.
5. Should a fire official choose to operate the Signal Silence button to silence the audio portion of the system, the control panel shall turn on an alarm silenced LED while the signals are in the silence mode. Should a new alarm occur after signal silence, all the alarm devices shall re-sound.
6. Air Handling Unit smoke detectors when activated shall shutdown the respective unit and all associated smoke and fire dampers. The exact location of all remote test stations shall be coordinated with the local fire department.
7. Upon activation of elevator lobby smoke detectors, elevator machine room smoke detectors and/or elevator shaft smoke detectors the respective elevator shall home to the main level. Once the elevators have reached the main level the elevator doors shall open and remain open until the system has been reset. If the

main level is in alarm, home the elevators to an alternate floor designated by the local fire department.
8. De-energize door holders to release all fire doors via new control modules at every existing door holder.
9. De-energize all access control systems to allow doors to swing open when freely via new control modules at every location.
10. Elevator machine room and elevator hoistway smoke detectors when activated shall start the hoistway exhaust fan and open the hoist-way louver to ventilate the shaft and shunt-trip power to the elevator circuit breakers.
11. The contractor shall provide a time delay on the main flow switch to allow time for a subsequent flow switch to alarm first and annunciated at the FACP.

E. Non-emergency User Operations:
1. Fire Alarm Control Panel (FACP) shall be equipped with full QWERTY keypad, Acknowledge/Signal, Silence/System, Reset/Drill switches, Automatic time control functions with holiday exceptions and Boolean logic equations.
2. Log a trouble and turn on a System Trouble LED for all user features, which modify, bypass, or inhibit the normal operations of the fire alarm life safety system. Suppress the common trouble signal during delivery of alarm signaling.
3. On the LCD, CPU, operation of the display ID code key shall annunciate the point identification address and description of the currently displayed device.
4. Operation of the menu key shall call a smart prompt program to guide the user through LCD, CPU programming operations. Restrict the use of this program by password.
5. Operation of the Reset/Drill Switch shall return the system to normal after all initiating devices have been returned to normal.

F. Supervisory Operations:
1. Operation of an addressable supervisory input device shall flash the supervisory queue indicator, sound a momentary audible signal, and display on the alphanumeric shared display. Display the type, condition, and a location message for the first alarm immediately without the need for operator response if no fire alarms are present. Log subsequent supervisory events in the supervisory queue for display by emergency user selection. Also, display the current total number of supervisory events and the chronological number of each event. Provide supervisory alarm priority to capture the display from a trouble or monitor event. Turn on a respective amber group individual zone LED at the control panel.
2. Activation of any system connected Carbon Monoxide detectors shall send a supervisory signal to a UL Approved central station monitoring company. The monitoring company shall retransmit the signal to fire department within 90 seconds and to the building manager.

G. Quality Assurance:
1. Install in accordance with the NFPA and the National Electrical Code.

H. Submittals:
1. Submit Shop Drawings for the control panel, voice evacuation control panel and all devices.
2. Submit custom operational sequences for the emergency communications, peripheral devices and fire alarm controls.
3. Submit pictorials or photographs of control equipment overviews, modular components, and interconnecting cable charts.
4. Provide system manuals, maintenance instructions and the name, address, and 24-hour telephone number of the service department of the SYSTEM SUPPLIER.

5. The Electrical Contractor shall provide as-built floor plans showing all devices, control panel, and connections to mechanical equipment. Drawings shall show all conduit routing and sizes, all wire sizes, types, and numbers.

I. Replacement of Defective Items:
1. Supply to the Architect a written agreement from the equipment manufacturer to supply new components to replace defective items without cost to the Contractor, where such defective items become evident during a period of one year from the approved certificate of completing.

J. Transponder:
1. Provide a Gamewell Multiplex transponder in each building to connect into the exiting campus loop.
2. Transponder shall be UL listed on NFPA 72 A, B, C, standards.
3. Program the transponders to operate upon activation of an alarm, OR supervisory condition.

K. Control Center:
1. The fire alarm control panel shall be in accordance with U.L. and N.F.P.A. requirements and be manufactured by Gamewell.
2. The system shall be housed in a surface wall mounted cabinet with a door and viewing windows as required. All annunciator indications, operating controls and instructions shall be clearly visible through the viewing window. The door shall be complete with a lock and two keys.
3. All electrical connections shall be front accessible through the hinged inner door.
4. The service console shall provide system activity LED's and event buffer display.
5. The single person installation verification test shall allow silent and non-silent testing of all system components. In addition, it shall produce a detailed report listing relay and signal programming for each verified input.
6. Provide the ability to field program on the panel or with the use of a personal computer equipped with system specific software. The software shall allow a qualified service technician to perform multiple level programming, detailed system diagnostics and print system summary reports. The FACP shall have an 80 column printer interface and two (2) USB ports.
7. Control panel shall be provided with a Radio Frequency shield to prevent interference and/or failure when firefighting personal key two way radios when in close proximity to the FACP.

L. Signaling Line Circuits

1. Provide the quantity of Signaling Line Circuits (SLC), style 4, 6 or 7 as indicated on the drawings. Each SLC shall be capable of monitoring 159 detectors (any combination of; ionization, photoelectric, thermal or multi-sensor devices) and 159 addressable modules (pull stations, normally open contact devices, two-wire smoke detectors, notification appliances, or relays) per SLC. 318 devices per loop, 3,180 devices per FACP.
2. Connect SLC's to a Loop Controller. Use solid, twisted pair, type FPLP wire in a metallic sheath with a red stripe. Connect SLC's, Class A style. Class B wiring shall not be acceptable.
3. Each SLC shall have a ground fault LED in the FACP to monitor the circuits for ground faults.
4. Each addressable device shall have a unique address. The manufacturer shall program each address and correlate them to output operations per the Plans and this Specification. Non-functioning, non-addressed and non-programmed devices shall report trouble. FACP shall provide for site modification to the addressable programming. The system shall provide for removal of devices

without the necessity of re-addressing any other devices. Provide installation flexibility to the contractor by insuring that the physical sequence (placement) of the devices on the loop need not determine the device address.

5. Address and connect, addressable alarm receiving devices to the addressable loop as recommended by the manufacturer. Devices on each SLC shall be polled in less than two seconds and activate in less than five seconds. The manufacturer shall provide installation tables to identify all device addresses.
6. Connect each normally open sprinkler supervisory device to a dedicated addressable transponder. Annunciate each supervisory addressable input device alarm or trouble operations on the LCD. Provide an individual status description on the LCD for each supervisory device.
7. Provide circuits to monitor auxiliary devices such as smoke dampers and fan operation as shown on the Plans. Annunciate open or shorts as required. Provide an individual status description on the LCD for each circuit and display a message on the LCD.
8. Provide programmable control modules at all the door holder and access control door locations. The control modules shall be wired such that upon activation of the fire alarm system the power to the door holders and access control equipment will be interrupted to allow the doors to fail safe.

M. Notification Appliance Circuits (NAC):

1. All NAC's shall be wired with power limited, Circuit Integrity (CI), supervised circuits, field programmable for any of the following operations:
   - Audible or Visual signals controlled by signal silence.
   - Audible or Visual signals controlled by system reset.
   - Remote auxiliary devices, which DO or DO NOT operate in the degraded mode. This shall be determined upon field requirements and be selectable during programming.
2. The FACP shall be equipped with a six (6) amp switch mode power supply with four Class A or B, built-in NAC circuits. All audio/visual devices shall be synchronized and field selectable as specified herein.
3. The system manufacturer shall provide, as necessary, auxiliary power supplies. The auxiliary power supplies shall provide power limited, supervised circuits for audio/visual devices. All auxiliary power supplies shall have built-in batteries and a charging circuit. Auxiliary power supplies shall be powered from a 120 volt dedicated, emergency power source. Exact quantity of auxiliary power supplies shall be coordinated with system manufacturer.

N. Auxiliary Relays:

1. Auxiliary relay module shall be provided with four, type "1C" site programmable relays.
2. Provide auxiliary relays with switches and status descriptions on the LCD for control functions as listed in the operations and as shown on the Plans. Relays shall be dust tight with fuse protected contacts rated at 24 VDC/120 VAC, 2.5amps. Inductive at a 35 power factor. Each relay will have a follower LED which verifies operation of the relay.

O. Fire Alarm Common Controls and CPU:

1. Common control/CPU shall be self-configurable and able to map to the display module by I/O module type. It shall have built-in field programmable software capable of being programmed and configured on site using either the built-in service console or a personal computer with system specific software. The computer shall be capable of connecting to the USB ports.
2. Provide a LCD CPU/Common Control Central Processing Unit with a 2 line 80-character LCD display and switches for common control, programming functions and alarm displays.
3. Universal Display modules shall connect to the CPU and provide all point identification and/or control functions.

4. Provide the following indicators: Power ON LED, Signals Silenced LED, Point Disabled LED, System Trouble LED, Supervisory LED, Security LED, Pre-Alarm LED, Fire Alarm LED, NAC #1 LED's, NAC #2 LED's, NAC #3 LED's, NAC#4 LED's, SLC #1 Ground Fault LED, SLC #2 Ground Fault LED and Earth Fault LED.
5. Provide the following keypad switch controls; Ground fault detection Enable/Disable, Disable/Enable switch for back-up alarms for (4) NAC's, Acknowledge/Scroll Display switch, Signal Silence switch, Drill switch, Reset switch and Lamp Test switch.
6. The Liquid Crystal Display (LCD) shall be of the super twist high contrast characters. Provide non-interleaving event display by type sorting input events into queues. Types shall be fire alarm, supervisory alarm, trouble, and monitor. Provide a full alpha numeric 80 character (2 x40) display to support site programming. Initiate a trouble signal if programming input is incomplete.

P. System Supervision:
1. Hardware or software fault detection shall activate the audible and visual trouble indicators. Operation of the silence push shall silence the audible signal, but the LED shall remain on. A new fault shall resound the signal. It shall not be possible to turn off the trouble LED until the system is clear of all faults. The common trouble circuit operation shall be independent of the CPU.

Q. Trouble Reporting:
1. All by-pass conditions such as auxiliary or fire department by-pass.
2. All wiring to all fire alarm devices.
3. Power connections and data transmissions.
4. All control panel hardware for placement.
5. All software routines and all program data for change.
6. All volatile memory for failure.
7. Primary and secondary power.
8. All field wiring for ground faults.
9. Maintain a record in memory of fault events.
10. Identify faults by code to simplify service trouble shooting. Standard system reset shall not erase this record.

R. System Power:
1. Provide primary operating power of 120 Volts A.C. 60 Hz. Use modular no break system power supplies with integral battery chargers capable of recharging within 12 hours.
2. Provide supervised secondary battery power to operate the entire system for 60 hours under normal conditions. At the end of 60 hours, the standby source shall power the system under alarm conditions for 10 minutes.

S. System Protection:
1. Provide high voltage transient protection all circuits. Minimum protection shall be 1000V for alarm receiving, 1500V for signaling, and 2500V for power supplies.
2. Protect sensitive electronics subject to static damage. Installer access to areas with static sensitive parts shall not be necessary.
3. Protect controls and annunciation behind locked doors all keyed alike. Provide door windows to allow viewing of all common controls and system annunciation.

T. Addressable Devices:
1. Provide input devices such as manual stations, smoke detectors, duct smoke detectors and heat detectors with built-in addressable transponders. Set a unique address at each device.

2. For heat detectors with fixed temperature ratings higher than 135 F, provide separately mounted transponders outside of, or away from the high heat areas.
3. Provide separately mounted transponders for other input devices such as:
   - sprinkler flow
   - sprinkler supervisory
   - low pressure switches

U. Flow, Tamper and Pressure Switches:
Provide Monitor modules for all existing Flow, Tamper and Pressure switches for adressability to FACP.
Pressure and Tamper switches shall be wired such that upon activation, a Supervisory signal is sent to Campus Security.

V. Addressable Pull Stations:
1. Manual Fire Alarm Stations shall be non-coded, dual action type pull station. The pull stations shall be capable of being opened without causing an alarm condition. An operated device is when the handle latches in the down position and the word "ACTIVATED" appears. This is the indication that the station has been operated. Each station shall be equipped with a built-in bicolor LED, which shall be visible through the handle of the station. The LED shall flash during normal operation and shall latch steady, RED when in alarm. Manual stations shall be constructed of molded durable Lexan with a textured finish. Stations shall be suitable for surface mounting on matching back box, or semi-flush mounting a standard single gang box and shall be installed not less than four and one-half feet above the finished floor. Manual stations shall be Underwriters Laboratories Listed. Provide an addressable monitor Modules with each station. Manual station shall comply with ADAAG guidelines for controls and operating mechanisms (Section 4.1.3, 13) and meet ADA requirements for 5 pounds maximum activation force. Each device shall be equipped with a key operated reset. Exact key configuration shall be coordinated with the local fire department.

W. Addressable Photoelectric Smoke Detectors:
1. The Contractor shall install, where indicated on the Plans, plug-in, two-wire intelligent Analog / Addressable Photoelectric type smoke detectors and matching bases. The detectors shall be the self-verification type and have integral analog communications, built-in type identifications, and two blinking LEDs. The LEDs shall blink each time the device is addressed, and shall be continuously illuminated when the detector is in alarm. The addressing switches shall be located in the detector bases which shall be directly connected to an SLC for two-way communication with the FACP. The bases shall accommodate matching ionization and thermal detectors. The bases shall be capable of mounting to outlet or device boxes and have provisions for surface mounting. The detectors shall have a built in test switch and shall be capable of remote testing from the FACP. Devices with addressable switches or settings in the heads shall not be accepted.

X. Addressable Heat Detectors:
1. The Contractor shall install, where indicated on the Plans, plug-in, two-wire intelligent Analog/Addressable fixed temperature heat detectors and matching bases. The detectors shall be continuously monitored to measure any change in their sensitivity due to temperature and have integral analog communications, built-in type identifications, and two blinking LEDs. The LEDs shall blink each time the device is addressed, and shall be continuously illuminated when the detector is in alarm. The addressing switches shall be located in the detector bases which shall be directly connected to an SLC for two-way communication with the FACP. The bases shall accommodate matching smoke detectors. The bases shall be capable of mounting to outlet or device boxes and have

provisions for surface mounting. The detectors shall have a built in test switch and shall be capable of remote testing from the FACP. Devices with addressable switches or settings in the heads shall not be accepted.

Y. Signal Appliances:

- Strobe Units

  Use red wedge shaped strobes clearly labeled "FIRE" in white letters. Polarize the strobes for supervised operation. Strobes shall provide a high intensity flashing light for visual signaling. Strobe units shall mount surface or flush as indicated on the plans and mount to a standard 4" x 2 1/8" back box with no extension ring required. Strobe Units shall be synchronized and comply with ADA and be UL approved. All strobe units shall be field selectable on the front of the unit with Multi-Candela settings of 15/30/75/110 candela.

- Signal Horn/Strobes

  The devices shall be comply with all appropriate sections of NFPA 72 and be capable of being wall or ceiling mounted. The NAC circuit wiring shall terminate at the universal mounting plate. Provide white units clearly labeled "FIRE". Each device shall produce a minimum of 75 Candela with a Xenon Strobe Light and an audible signal that will produce not less than 87 dba sound output. Horn/Strobe devices shall be synchronized and comply with ADA and be UL approved. Mount devices flush or surface as indicated on the plans and mount to a standard 4" x 2 1/8" back box with no extension ring. All horn/strobe units shall be field selectable on the front of the unit with Multi-Candela settings of 15/30/75/110 candela and have at least two (2) selectable horn tones and three (3) decibel settings. The strobe light shall consist of a xenon flash tube and associated lens/reflector system.

Z. Auxiliary Devices:

1. Provide remote control relays connected to supervised auxiliary circuits for control of fans, dampers, door releases, etc. Relay contact rating shall be 5 amperes at 120 VAC resistive or 2.5 amperes at 120 VAC inductive for a .5 power factor.
2. Provide flush wall mounted electromagnetic door holders at all the fire door locations. Holders shall mount to a standard single gang outlet box. Holders shall be rated 24V DC and shall release upon activation of the fire alarm system.
3. Beacon, provide a 24 VDC exterior Weatherproof Beacon constructed with a Lexan lens a heavy duty xenon strobe lamp. Beacon shall be similar to Amsec SL-5 or equal.

AA. Installation:

Install a new Fire Alarm Control Panel as indicated on the drawings. Power to the new FACP shall originate from an emergency life safety panel board.

Install new auxiliary power supplies, complete with battery back-up as indicated on the drawings. Power to the new power supplies shall originate from an emergency life safety panel.

Install new horn/strobe devices throughout the facility including all corridors and common areas as indicated on the drawings. These devices shall be flush mounted at the heights indicated on the drawings. These devices shall be connected to a new NAC circuit with 2/C #14 Shield type CI-FPLP wire.

Install new automatic alarm initiating devices (ie, manual pull stations, smoke detectors, heat detector, flow switches, duct smoke detectors, etc.) as indicated and connect to a SLC. Mounting heights and locations shall be as indicated on the drawings.

Install duct detectors and Remote Test Stations in HVAC equipment as indicated on the drawings. Mount duct smoke detectors at a suitable location in the supply air duct work of units 2000 cfm or greater. In units that are rated 15,000 cfm or greater, duct smoke detectors and remote test stations shall be installed in both the supply and return air streams of the unit. Mounted duct detectors in a readily accessible location for maintenance.

Install audible signal devices as indicated and connect to NAC's. NAC wiring shall be suitable for Class II.

If required, install Bi-Directional Antenna system and all associated wiring, power supplies antennas, etc. for two-way communications between the control panel and the floors.

Connect all new door holders to the fire alarm system such that the designated doors release upon activation of the fire alarm system.

Connect all access control door controllers to the fire alarm system with a new programmable control module. The control module shall be programmed to interrupt the power to the access control door equipment to allow the respective door to swing open freely.

The electrical Contractor shall furnish and install a GREEN LED in the fire alarm control panel to indicate the Emergency Generator running after transferring to emergency power.

All fire alarm riser cables shall be type "CI" (circuit integrity) cable if run exposed or Metal Clad type "MC" with solid conductors in a two-hour rated shaft or enclosure.

All fire alarm wiring shall be Metal Clad type "MC" with solid conductors. The contractor shall be responsible for the supply and installation of the cable, wire, wire pulling, junction boxes, electrical boxes, and terminal cabinets in accordance with the manufacturer's recommendations but shall be no smaller than what is indicated on the drawings. The manufacturer shall allow for the necessary amount of onsite assistance for the contractor during the construction period.

BB. Verification and Certification:
The manufacturer shall make an inspection of the Life Safety equipment. The inspection shall include all equipment necessary for the direct operation of the system such as input and output devices. Verify wiring connections to ensure that all equipment meets applicable codes and standards. Verify equipment supplied by the manufacturer has been installed per the manufacturer's recommendations. Verify the operation of all devices. Verify the wiring to all supervised devices is supervised.

CC. Power-limited fire alarm cable shall be used in power-limited circuits in accordance with Article 760 of ANSI/NFPA 70, "National Electrical Code" (NEC).

DD. Unless a higher temperature rating is marked on the cable, power-limited fire alarm cable is intended for use where operating temperature does not exceed 60°C. The voltage rating shall be 300 Volts.

EE. Power-limited fire alarm cable shall be identified by a marking on the surface of the jacket or on a marker tape under the jacket. This marking shall include one of the following Type designations:

FPLP — Indicates cable intended for use within buildings in ducts or plenums or other spaces used for environmental air in accordance with Section 760.154(A) of the NEC. This cable shall exhibit a maximum peak optical density of 0.5, a maximum average optical density of 0.15, and a maximum flame spread distance of 5 ft when tested per ANSI/NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces."

FPLR — Indicates cable intended for use within buildings in vertical shafts in accordance with Section 760.154(B) of the NEC. The flame propagation height of this cable shall be less than 12 ft when tested per ANSI/UL 1666

"Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts."
Power Limited Fire Alarm Cable — Indicates cable suitable for use within buildings (1) where the cable is enclosed in a raceway, or (2) in non-concealed spaces where the exposed length of cable does not exceed 10 ft, in accordance with Sections 760.154(C)(2) and (3) of the NEC. This cable shall comply with the VW-1 Flame Test requirements in ANSI/UL 1581. Cable marked "sunlight resistant" or "sun res" may be exposed to the direct rays of the sun.
Cable marked **"CI (max voltage 300)"** is suitable for use as circuit integrity cable at the maximum voltage to ground indicated, in accordance with Section 760.179(G) of the NEC.
Cable marked "wet" or "wet location" is suitable for use in wet locations.

FF. All conductor wires and cables for fire alarm circuits shall consist of thoroughly tinned 98 percent conductivity copper.

GG. Wires shall be a minimum of, #14/2 Shielded for the audio/visual circuits and #14 Twisted Pair for initiating circuits. All cables shall be solid conductors, unless otherwise noted or shown on plans.

HH. All wire shall be color-coded.

II. All wire and cable shall be as manufactured by General Cable, Rome Cable, Anaconda, or approved equal.

JJ. Fire alarm cables shall be secured by insulated staples, cable-ties, straps and/or hangers at intervals not to exceed 6’-0’ on center and within 12” of every cabinet, box or fitting.

2.38 AUTOMATIC LOAD TRANSFER SWITCHES

A. Automatic transfer switches shall be furnished with full load current rating as indicated on the drawings at 120/208 volts, 3 phase, 4 wire, 60 hertz, A.C. normal and emergency as indicated. The transfer switches shall be capable of switching all classes of load, and shall be rated for continuous duty when installed in a non-ventilated enclosure that is constructed in accordance with Underwriter’s Laboratories, Inc., Standard UL-1008.

B. The transfer switches shall be double throw, actuated by a single electrical operator momentarily energized; and connected to the transfer mechanism by a simple overcenter type linkage with a total transfer time not to exceed one-half (1/2) second. The transfer switches shall be capable of transferring successfully in either direction with 70% of rated voltage applied to the switch terminals. The withstand and closing rating shall be no less than 65,000.

C. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in position in both the normal and emergency positions without the use of hooks, latches, magnets or springs; and shall be silver-tungsten alloy protected by arcing contacts, with magnetic blowouts on each pole.

D. The transfer switches shall be equipped with a permanently attached manual operator that is designed to prevent injury to the operating personnel, if the electrical operator should suddenly become energized during manual transfer. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly.

E. Engine starting contacts shall be provided to start the generating plant, if any phase of the normal source drops below 70% of rated voltage, after an adjustable time delay period of three (3) to thirty (30) seconds, to allow for momentary dips. The transfer to emergency as soon as the voltage and frequency have reached 90% of rated voltage. After restoration of normal power on all phase to 90% of rated voltage, an adjustable time delay period of 0-30 minutes shall delay re-transfer to normal power, until it has had time to stabilize. If the emergency power source should fail during the time period, the time delay shall be by-passed, and the switch

shall return immediately to the normal source. After the switch has retransferred to normal, the engine generator shall be allowed to operate at no load for an adjustable period of time (0-5 minutes) to allow it to cool before shut down. The transfer switches shall include a test switch to simulate normal power failure, pilot lights on the cabinet door to indicate the switch closed on normal or emergency and four (4) auxiliary contacts on the main shaft; two (2) closed on normal, the other two (2) closed on emergency. The transfer switches shall also be provided with pre-elevator signal contacts, and a 7-day with/without load exerciser.

F. Load transfer switches shall be as manufactured by ONAN.

2.30 EMERGENCY GENERATOR (Outdoor)

A. Furnish and install a complete and operating emergency power and lighting system as specified herein and as indicated on the Drawings.

B. The system shall be arranged to provide automatic and instantaneous emergency lighting upon failure of normal lighting in any of the supervised areas. This system shall meet all Code requirements for emergency lighting.

C. Furnish complete, install, and leave in good running condition, a Cummins #400DFEG, 400 KW diesel, engine driven generating set continuously rated for emergency standby service. The 400 KW rating shall be continuously available during any power outage. The unit shall be as hereinafter described as shown on the Drawings, complete with all controls, attachments, accessories, fuel and exhaust systems.

D. The unit shall be the product of a manufacturer regularly engaged in the production of this type of equipment as manufactured by Cummins.

E. The unit shall meet the latest emission requirements set forth from the EPA.

E. The unit shall be capable of accepting the incoming loads of Automatic Transfer Switches. Shop Drawing Submittal for emergency generator shall include a signed statement from the manufacturer's representative stating that:

(1) Manufacturer's representative has reviewed all loads to be connected to the emergency system.

(2) The submitted emergency generator shall capable of automatically starting and running the loads indicate on the drawings.

F. OPERATION

1. The operation of this unit shall be automatic and upon the closing of a remote starting contact in Automatic Transfer Switch the engine shall start and attain rated voltage and frequency within ten (10) seconds.
2. All necessary accessories shall be provided to assure starting within the time described above under the ambient conditions described herein.
3. Furnish and install all electrical work and equipment required for the proper operation of this system. The General Contractor shall provide the concrete pad for the emergency generator. The Electrical Contractor shall provide weight information, as well as dimensional information of the generator to the General Contractor.

G. ENGINE

1. Engine shall be water-cooled, six cylinder, four cycle, turbocharged industrial type, diesel fueled, with a minimum displacement of 15 liters, and a maximum rated output of at least 630 B.H.P. at a maximum R.P.M. of 1800.
2. Lubrication shall be a full pressure system using an engine driven gear-type lube oil pump with replaceable element full flow lube oil filter. Oil cooler shall be required.
3. Fuel System, Diesel

   The engine fuel system shall include all equipment normally supplied and recommended by the generator set manufacturer for standby generator service.

   The system shall be mounted and piped in the enclosure supplied by the engine generator set supplier.

The fuel system shall be in compliance with all state and local codes.

4. Governor
   a. The engine shall be equipped with an electronic isochronous governor capable of maintaining the engine speed from no load to full load within .25% of the synchronous speed.
5. Starting System
   a. The engine shall have a 24 V.D.C. starting system with one (1) starting motor and starter solenoid switch.
   b. Batteries - One set of starting batteries with cables and steel battery rack, shall be included, batteries shall be heavy-duty lead acid type, rated 220-ampere hours.
   c. Float type battery charger shall be supplied to maintain the starting batteries at full charge. The charger shall be suitable for wall mounting (or may be mounted in the transfer switch) and shall have a cranking disconnect relay or current limiting feature. The charger shall be LaMarche. Battery charger shall be prewired to generator terminal strip prior to shipment. Battery charger shall include high and low battery voltage alarm relays for annunciator panel and be LaMarche Model A18-3-24V. Include high and low voltage alarm relay.
   d. There shall be a belt drive 45 amp battery-charging alternator with regulator and charge rate ammeter for charging the batteries while the engine is running or the float type battery charger may be arranged to charge the batteries from the normal source when the engine is shut down and from the generator output when the generator is operating. This shall be accomplished by a relay energized from the generator output.
6. Jacket Water Heater
   a. A 1500-watt engine jacket water heater shall be provided to maintain the engine jacket water at a temperature high enough to assure starting the engine and attaining rated voltage and frequency within ten (10) seconds. The jacket water heater shall be of the capacity recommended by the generator set manufacturer to meet the above conditions. Input voltage to the heater shall be 208 volt-1-60HZ factory wired to the panel board built into the generator enclosure.
7. Lubricating Oil Heater
   a. A 300-watt engine lubricating oil heater shall be provided with the same functions as jacket water heater. Input voltage to the heater shall be120 volt-1-60HZ factory wired to the panel board built into the generator enclosure.
8. Alternator Heater
   b. A 150-watt alternator heater shall be provided to limit condensation at the alternator. Input voltage to the heater shall be120 volt-1-60HZ factory wired to the panel board built into the generator enclosure.
9. Engine Cooling System
   a. The engine shall be equipped with a unit mounted radiator cooling system complete with unit mounted radiator, circulating water pump, by-pass thermostat, and radiator belt guards. The radiator shall be supplied to operate in an ambient temperature of 122 degrees F.
   b. The cooling system shall be filled with a 50% solution of ethylene glycol and water.
10. Safety Shutdown
    The engine shall be equipped with safety contacts for:
    a.) low jacket water temperature
    b.) low lube oil pressure
    c.) high jacket water temperature
    d.) overspeed
    e.) overcrank
    f.) high oil temperature
11. Engine Instruments

The following engine instruments shall be included either in an engine instrument panel or in the digital generator control panel:

a.) lube oil temperature
b.) lube oil pressure
c.) water temperature
d.) D.C. ammeter
e.) Frequency Meter
f.) Tachometer
g.) Any other instruments considered necessary by the manufacturer shall be included.

12. Exhaust System
    a. A high degree exhaust silencer suitable for hospital type silencing complete with condensate drains shall be supplied of the size recommended by the generator set manufacturer, but in no case less than 3 inches. Silencer shall be as manufactured by Kettell, Maxim, or Burgess Manning. An octave band center frequently in Hertz data sheet shall accompany all Muffler Shop Drawings. A section of seamless, flexible stainless steel exhaust connection of the size and type recommended by the generator set manufacturer, but in no case less than 3 inches diameter and eighteen (18) inches long. If the engine is Vee type, a single exhaust outlet header shall be supplied.
13. Mounting
    a. The engine and generator shall be close coupled and mounted on a structural steel base designed to maintain proper alignment of the unit.
    b. The unit shall be certified by the manufacturer to be free from any critical torsional vibrations within a range of plus or minus 10% of synchronous speed.
    c. Vibration isolators of the rubber pad type shall be supplied with the unit. The number of isolators shall be as recommended by the generator set manufacturer.
    d. Vibration isolators shall be Korfun MMB Series or equal by Consolidated Kinetics or Vibration Eliminator.
    e. GENERATOR
        a.) Rating – 200 KW, 250 KVA, 0-8 P.F., 3 phase, 60 cycle, 120/208 volts. Tier III certified.
        b.) Type - Revolving field, 4 pole, single bearing, drip-proof.
        c.) Exciter - brushless, direct connected, fully tropicalized, SCR rectifiers, static voltage regulator, Rheostat, excellent motor starting capability. PMG shall be provided with a minimum SKVA of 920.
        d.) Voltage Regulation - Plus or minus 1% of any preset value over the three (3) phase load range. Instantaneous voltage dip or rise when measured with an oscilloscope, will not exceed 20% upon full load application or rejection, and will return to preset value within 0.5 seconds.
        e.) Waveform - Deviation factor of output voltage will not exceed 5% and the value of any individual harmonic will not exceed 2% of the fundamental when operating with an unbalanced load.
        f.) Temperature Rise - Temperature rise of any component will not exceed 105 degree C.
        g.) Rotor-One (1) piece laminations welded and secured to shaft by a key and press fit. Mortisseur windings installed and connected between poles as an aid to parallel operation and improved waveform during unbalanced loads. Field coils machine would on insulated pole body and securely braced. Rotor statically and dynamically balanced.
        h.) Stator-One (1) piece laminations welded together. Stator pressed and welded in a rigid steel frame.
        i.) Bearing-Double sealed ball bearing, lubricated for life.
        j.) Insulation-NEMA Class H insulation.

k.) Varnish-Three (3) coats modified polyester type will not support fungus growth.
l.) Cooling-Cast aluminum fan mounted on generator shaft.

f. Radio Suppression - Radiated or conducted radio interference will not affect normal commercial apparatus.
g. (Unit Mounted) the engine generator set shall include a combination engine generator digital control panel shock mounted at the generator end of the unit. This unit mounted panel shall include (but not be limited to) the following:
   a.) water temperature gauge
   b.) oil pressure gauge
   c.) D.C. battery charge rate ammeter
   d.) A.C. voltage regulator
   e.) voltage adjusting rheostat
   f.) start-stop switch
   g.) A.C. voltmeter, 3 ½" diameter, .5 accuracy
   h.) A.C. ammeter with current transformers, 3 ½" diameter, .5 accuracy
   i.) combination VM-AM phase selector switch
   j.) frequency meter/tachometer, digital
   k.) elapsed time meter, digital
   l.) automatic start-stop control with faulty indicating lights and corresponding safety switches for:
      - low oil pressure (prewarn and shutdown)
      - overcrank protection (manual reset)
      - high water temperature (prewarn and shutdown)
      - overspeed
      - overcrank
      - selector switch - "off, auto, manual" with light for "selector switch off"
h. 100% Rated Manual reset line circuit breakers shall be , (2) 3 pole, 400 amp frame, 400 amp trip, mounted in NEMA I enclosures with an interrupting capacity of 65,000 amps, sym, at 208 volts.
   a.) The control shall be designed to start the engine upon a closure of a remote contact, arm all safeties, and shutdown the engine when the remote contact is re-opened.
   b.) The control must be manually reset following any fault condition.
   c.) Control power shall be from the engine start battery.

H. DERANGEMENT PANEL

1. A flush remote mounted engine generator derangement panel shall be built, tested, and supplied by the generator supplier. The derangement panel shall be located in the maintenance office and monitor, visually and audibly, the following:

   - Generating (visual only)
   - High water temperature
   - Low water temperature
   - Low oil pressure
   - High oil temperature
   - Overspeed
   - Overcrank
   - Battery charger malfunction
   - High fuel level - day tank
   - Low fuel level - day tank
   - Alarm silenced (visual only)
   - Panel mounted alarm

- Alarm on/off switch

I. WEATHERPROOF ENCLOSURE

1. A weatherproof aluminum enclosure (Quiet Site II) shall be provided with all accessories specified herein, mounted, piped, and wired to terminal strips within the enclosure, except for automatic transfer switches. Provide fixed louvers for radiator exhaust and incoming air. Enclosure shall be sound attenuated to achieve 72.0dba at 23 feet.
2. The sheet metal enclosure shall have hinged panel doors and shall have fixed louvers and gasketed seams to insure weatherproof construction. The housing shall utilize E-coat paint process insure no rusting or utilize aluminum, No exceptions will be accepted.
3. Silencer shall be mounted inside the enclosure and the exhaust pipe shall terminate in a suitable "Shanty Cap".

J. FUEL SYSTEM

The generator shall be diesel fired and provided with skid mounted, 24 hour fuel tank.

K. TEST

1. The supplier of the equipment shall provide with no additional charge, any information or supervision required for the proper installation of the equipment. Upon completion of the installation of this unit a test run for four hours shall be conducted by the equipment manufacturer's factory trained serviceman, utilizing load banks to attain full generator rating. At this time adjustments shall be made for correct operation of the equipment and the following readings taken at 15 minute intervals:
   a. Engine jacket water temperature
   b. Generator temperature
   c. Oil pressure
   d. Battery charge rate
   e. A.C. volts
   f. A.C. amps (all legs)
   g. Engine air exhaust temperature
   h. Engine oil temperature
2. The second test shall be made by utilizing available connected load. The supplier of this equipment shall also furnish and install lube oil in the engine and also drain and refill the engine with new lube oil after the engine-generator test has been completed. If the engine-generator test has been completed. If the engine-generator unit should fail this initial test run, as determined by the representative of the Owner, after proper corrective measures have been implemented, replace engine lube oil again after the second test. If any additional tests are required to prove the performance of the engine-generator unit, lube oil shall be replaced after each such test run.
3. Prior to shipment of generator to the job site, conduct 3-hour full load shop test utilizing resistive load to attain full rated load. A written report of this test shall be forwarded to the Engineer for approval prior to shipment. All expenses for these tests shall be carried by the Electrical Subcontractor. Notify Engineer one (1) week prior to shop test. Shop test may be witnessed.

PART 3.00 – EXECUTION

3.01 GENERAL PROVISIONS

A. All locations of equipment and materials are subject to review by the Architect in order to coordinate with field conditions.

3.02 TESTS

A. The right is reserved to conduct acceptance texts of all equipment wiring or any other work furnished under these Drawings and/or Specifications to determine the fulfillment of specific requirements and/or design.

B. The Contractor shall perform all tests, supply all instrumentation, personnel and make all adjustments of equipment and wiring as may be necessary. Insulation resistance readings of all equipment and circuits shall be taken by the Contractor in the presence of the Owner's representative. Megger readings of less resistance than the recommended minimum as called by Section 110-7 of the NEC shall be required or replaced by this Contractor at no cost to the Owner.

3.03 GROUNDING

A. The Contractor shall furnish and install all material required for grounding and/or bonding in the building of all equipment, power systems, all as shown on the Drawings and/or specified, as a minimum.

B. Grounding shall conform to NEC Article 250.

3.04 INSTALLATION OF WIRING AND CONDUIT

A. In general, all wiring is to be run concealed unless otherwise indicated to be run exposed. Exposed wiring in the mechanical spaces is acceptable.

B. Raceways shall be continuous from outlet to outlet and from outlets to cabinets, junction and pull boxes, and shall enter and be secured to all boxes in such manner that each system shall be electrically continuous from service to all outlets. Terminal of all conduits shall be furnished with double locknuts and bushings.

C. Exposed conduits shall be run parallel to or at right angles to the wall of the buildings, and all bends shall be made with standard ells or bent to not less than the same radius. Horizontal runs of exposed conduits shall be close to ceilings, passing over water or other piping where possible and shall be supported by pipe straps or by other approved means, not more than five feet apart.

D. In no place shall conduit be run within six inches of hot water pipes or appliances, except where crossing is unavoidable, and in that case the conduit shall be kept at least one inch from covering of pipe crossed.

E. Conduits shall be supported on approved types of galvanized wall brackets, ceiling trapeze, strap hangers or pipe straps, secured by means of toggle bolts on hollow masonry, machine screws on metal surfaces or wood screws on wood construction. No nails shall be used as a means of fastening boxes or conduit.

F. In general, no splices or joints will be permitted in feeder cables, and branches shall be spliced at outlets or accessible junction boxes.

G. All splices in wire #6 AWG and smaller shall be standard pig-tail made mechanically tight, then cleaned, and insulated with proper layers and thickness or rubber and friction tape. Wire splicing nuts, Thomas and Betts, Sta-Kon or Minnesota Mining and Manufacturing Co., Scotchlock Type R, may be used subject to approval of the local inspector. Joints, tape and splices in wire #6 AWG and larger shall be taped with approved rubber and friction tapes providing insulation not less than that of the conductor over Burndy Servits or equivalent connectors made by Penn Union or Blackburn.

H. Wire #6 AWG and larger shall be connected to panels and apparatus by means of approved lugs and connectors. Connectors shall be solderless type, sufficiently large to enclose all strands of the conductor and securely fastened.

I. Wiring method shall conform to local wiring inspector. Prior to submitting bid, Contractor shall confirm wiring method to be allowed by local ordinances.

3.05 INSTALLATION OF OUTLET BOXES

A. Outlet boxes shall be of size and type to accommodate structural conditions; size and number of raceways; conductors or cables entering; and device or fixture for which required.
B. Install blank plates on all outlet boxes in which no apparatus is installed, which do not integrally provide a cover for box.
C. Special care should be taken to set all boxes correctly, square and true with the building finish. The edge of the box shall come flush with the building finish. As far as possible, all wall and switch outlets shall be erected in advance of furring and fireproofing and shall be secured to the building structure or steel by adjustable strap iron supports, which shall be buried.
D. The exact location of all outlets and switches in finished rooms shall be obtained from the Architect and from the scale drawings of interior details and finish. Final correct readjustment shall be made to outlets, if necessary, to give proper centering.
E. The locations given or designated on the Plans for the outlets are subject to notifications. In the case of local wall switches to be set at or near doors, the definite location shall be as established on the side of the door opposite the hinge.

3.06 JUNCTION AND PULL BOXES

A. Junction and pull boxes shall be furnished and installed under this Section of the Specification where indicated on the Drawings and wherever else such a box may be deemed necessary to facilitate the pulling or splicing of wire and cable.
B. All such boxes must be made accessible and shall be built only from the approved detail working Drawings. Conduits shall enter these boxes through tight-fitting clearance holes.
C. The covers of the boxes shall be designed for quick removal. Where junction boxes are required for a splicing box for special recessed fixtures, consult the Architect before installing boxes for these fixtures and determine the exact location of the boxes.
D. Each feeder passing through a pull box shall meet the approval of the Architect. Generally, junction boxes and pull boxes shall not be exposed in finished areas; where necessary, reroute conduits or make other arrangements to meet the approval of the Architect.
E. Outlet, pull and junction boxes shall be properly sealed during the course of construction to prevent the entrance of dirt and foreign materials within same or the raceway system of which it is part. The Electrical Contractor shall provide temporary covers for all open boxes. Paper shall be solidly packed into standard work boxes to prevent the entrance of dirt and foreign materials, in lieu of cover plates if so elected by the Electrical Contractor.

3.07 LIGHT SWITCHES

A. In general, convenience outlet circuits shall be independent of light circuits. In all cases the light switches shall be located opposite hinge side of door, per latest Architectural Drawings

3.08 GENERAL PANEL INFORMATION

A. All panels shall be properly balanced, the circuit numbers on the Plans being a numerical indication rather than any attempt to indicate proper balance.
B. Care shall be taken in the use of a common neutral to make certain that no more than one leg is taken form each phase.
C. Typed directories shall be provided in each panel indicating circuit number and the outlets or items controlled or fed from same.

3.09 MOTOR WIRING

A. The Contractor shall do all wiring required for plumbing, ventilating and heating motors including mounting of switches and starters, as well as wiring of same. All

wiring for the control of motors, unless indicated on Electrical Plans, shall be indicated in HVAC, Plumbing and Fire Protection Sections.

B. The Mechanical Contractor shall furnish starters to be installed by the electrical contractor. The electrical contractor shall furnish and install fused disconnecting means as required by the National Electrical Code for all motors. Motor-driven equipment specified under "Plumbing" and "Heating and Ventilating" nay be factory wired complete with controller and motor disconnects; therefore, the Contractor should check equipment purchased under these divisions so as to avoid duplication of protective and disconnecting means. Motor disconnects shall be fused unless noted otherwise. Single phase disconnects may be thermal switches.

C. The Contractor shall furnish and install a fused disconnect at each HVAC unit. Fusing shall be per manufacturer's recommendation. Prior to wiring HVAC units, Contractor shall review submittals on equipment for electrical characteristics.

3.10 VOICE/DATA CABLING

A. The General Contractor shall furnish and install a fire rated plywood backboard for tel/data equipment as indicated on the drawings.

B. Contractor shall furnish and install incoming raceways to the main tel/data room as indicated on the drawings. The exact location of the conduit system shall be determined in field.

C. Contractor shall furnish and install 400 pair outside plant feeder telephone cable running from the Linnell Hall the main tel/data room of the new facility.

D. Contractor shall furnish and install 18 fiber multi-mode outside plant feeder cable running from Linnell Hall main tel/data room to the main tel/data room of the new facility.

3.11 FIRE ALARM SYSTEM

A. INSTALLATION

1. Fire alarm system shall be wired in accordance with manufacturer's complete Wiring Diagram as submitted with Shop Drawings.
2. Fire alarm cable shall be utilized for wiring system components associated with the data loops.
3. Provide two complete Wiring Diagrams and maintenance manuals to be turned over to Owner. Provide one additional Wiring Diagram and maintenance manual in control panel.
4. Entire system shall be guaranteed for one year after final acceptance.
5. Provide and install the system in accordance with the Plans and Specifications, all applicable codes and the manufacturer's recommendations. All wiring shall be installed in strict compliance with all the provisions of NEC-Article 760 A and C, Power-Limited Fire Protective Signaling Circuits or if required, may be reclassified as non-power limited and wired in accordance with NEC-Article 760 A and B. Upon completion, the Contractor shall so certify in writing to the Owner and General Contractor. All junction box covers shall be painted red and labeled "Fire Alarm". Wiring color code shall be maintained throughout the installation.
6. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate Subcontractors.
7. The Contractor shall clean all dirt and debris from the inside and the outside of the fire alarm equipment after completion of the installation.
8. The manufacturer's authorized representative shall provide onsite supervision of installation.

B. TESTING

1. The completed fire alarm system shall be fully tested in accordance with NFPA-72H by the Contractor. Upon completion of a successful test, the Contractor shall so certify in writing to the Owner and General Contractor.

C. WARRANTY

1. The Contractor shall warrant the completed fire alarm system wiring and equipment to be free form inherent mechanical and electrical defects for a period of one year from the date of first beneficial use.
2. The equipment manufacturer shall make available to the Owner a maintenance contract proposal to provide a minimum of two inspections and tests per year in compliance with NFPA-72H guidelines.

D. GENERAL

1. The work covered by this Section of the Specifications includes the furnishing of all labor, equipment, materials, and performance of all operations in connection with the installation of the Fire Alarm System as shown on the Drawings and as herein specified.
2. The requirements of the conditions of the Contract, Supplementary conditions and General Requirements apply to the work specified in this Section.
3. The complete installation shall conform to the applicable sections of NFPA-72 (A), (B), (C), (D), (E), (F), Local Code Requirements and National Electrical Code with particular attention to Article 760.
4. The work covered by this Section of the Specifications shall be coordinated with the related work as specified elsewhere under the project Specifications.

E. QUALITY ASSURANCE

1. Each and all items of the fire Alarm System shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the "U.L." label. All control equipment shall be listed under UL category UOJZ as a single control unit. Partial listing shall not be acceptable.
2. In addition to the UL-UOJZ requirement mentioned above, the system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC Article 760-23.

3.12 EMERGENCY GENERATOR

A. The Electrical Contractor shall install the Emergency Generator in accordance with the manufacturer's directions.
B. The Electrical Contractor shall verify all clearances, dimensions and weights.
C. The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided. All testing shall be performed with calibrated metering.
D. Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.
E. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
F. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections

(when required), under the supervision of the equipment supplier.

G. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

H. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the consulting engineer.

I. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

J. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

K. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system.

L. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.

M. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two hour full load (resistive) test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.

N. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

O. The generator set supplier shall issue a test report documenting the results of testing, and including a complete list of all settings in the control system.

P. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

Q. The generator set supplier shall maintain service parts inventory for the entire power system at a central location which is accessible to the service location 24 hours per day, 365 days per year. The inventory shall have a commercial value of $3 million or more. The manufacturer of the generator set shall maintain a central parts inventory to support the supplier, covering all the major components of the power system, including engines, alternators, control systems, paralleling electronics, and power transfer equipment.

R. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical power system replacement parts in the local service location. Service vehicles shall be stocked with critical replacement parts. The service organization shall be on call 24 hours per day, 365 days per year. The service organization shall be physically located within 50 miles of the site.

S. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

3.13 QUIET OPERATION

A. All equipment and material furnished by this Contractor shall operate under all conditions of load without objectionable noise or vibration, which in the opinion of the Architect is objectionable. Where sound or vibration conditions occur, which the

Architect considers objectionable, this Contractor shall eliminate same in a manner approved by the Architect.

3.14 RECORD DRAWINGS

A. A set of as-built Record Drawings, consisting of a reproducible set of Architect's Drawings with additional sketches as required, denoting and dimensioning accurately all changes in elevation location and size of material deviating from the Architect's Drawings, shall be kept concurrently with the progress of the installation. Upon completion of the work, the Contractor shall deliver to the Architect an up-to-date set of these as-built Record Drawings.

3.15 SUPPLEENTARY STEEL, CHANNELS AND SUPPORTS

A. Supplementary steel and channels shall be firmly connected to building construction in a manner approved by the Architect prior to the installation of same. The Electrical Contractor shall submit to the Architect, via the General Contractor the location where he proposes to use supplementary steel and channels, for the support of equipment, fixtures and raceways. The submittal shall indicate the mounting methods, size, and details of the supports, channels and steel. It shall indicate also the weight, which the supports, channels and supplementary steel are to carry.

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Protecting existing trees, shrubs, groundcovers, plants and grass to remain.
2. Removing existing trees, shrubs, groundcovers, plants and grass.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site features and appurtenances.
6. Disconnecting, capping or sealing, and abandoning site utilities in place and/or removing site utilities.

B. Related Sections include the following:

1. Division 01 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities.
2. Division 02 Section “Existing Utilities and Structures”
3. Division 02 Section “Selected Site Demolition”
4. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
5. Division 32 Section "Turf and Grasses" for finish grading including preparing and placing planting soil mixes and testing of topsoil material.
6. Division 32 Section "Planting" for soil materials required for plantings.
7. Drawing C300 "Erosion & Sedimentation Control Details & Specifications”" for erosion and sedimentation control measures.

1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and friable sand, silt, and clay particles found in a depth of not less that 4 inches; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Record drawings, according to Division 01 Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within fenced area.
2. Do not permit vehicles, equipment, or foot traffic within fenced area.
3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated or directed.

C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

1. Cover exposed roots with burlap and water regularly.
2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
3. Coat cut faces of roots more than 1-1/2 inches (38 mm) in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
4. Backfill with soil as soon as possible.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Owner's Representative.

1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
2. Replace trees that cannot be repaired and restored to full-growth status, as determined by Owner's Representative.

3.3 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Unsound or unsightly branches of trees and shrubs designated to remain, and not specified to be removed under another item shall be removed as directed. All such removing and the disposal shall be a part of and incidental to this item
3. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
4. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches (450 mm) below exposed subgrade.
5. Use only hand methods for grubbing within tree protection zone.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground.

3.4 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Where trees are indicated to be left standing, stop topsoil stripping at the free drip line or as necessary to prevent damage to the main root system

D. Stockpile topsoil materials away from edge of excavations, or where directed, without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Limit height of topsoil stockpiles to 72 inches (1800 mm).
2. Do not stockpile topsoil within tree protection zones.
3. Dispose of excess topsoil as specified for waste material disposal.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.5 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.6 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property, unless otherwise directed by Owner’s Representative

END OF SECTION

SECTION 31 20 00

EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. A geotechnical report has been prepared for this project and is an integral part of this document. Should any discrepancies arise between these specifications and the geotechnical report said report shall govern. The contractor shall notify the Owner's Representative if any such discrepancies arise.

1.2 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade.
2. Preparing subgrades for pavements.
3. Preparing subgrades for lawns and grasses.
4. Preparing subgrades for exterior plants.
5. Excavating and backfilling for buildings and structures.
6. Subbase and base course for walks or pavements.
7. Subbase and base course for roadway paving.
8. Subsurface drainage backfill for walls and trenches.
9. Excavating and backfilling for utility trenches.
10. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

B. Related Specifications are included in the following:
1. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities.
2. Division 02 Section "Existing Utilities and Underground Structures" for coordination of work on existing utilities and structures.
3. Division 31 Section "Erosion and Sedimentation Control" for temporary erosion and sedimentation control measures
4. Division 31 "Site Clearing" for site clearing, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
5. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
6. Division 32 Section "Turf and Grasses" for finish grading, including preparing and placing topsoil and planting soil for lawns.

7. Division 32 Section "Plants" for planting bed establishment and tree and shrub pit excavation and planting.
8. Division 33 Section "Subdrainage" for drainage of foundations, slabs-on-grade, walls, or landscaped areas.
9. Drawing C-300 "Erosion & Sedimentation Control" notes and details of erosion and sedimentation control measures.

C. References Included in this Section:
1. ASTM- American Society for Testing & Materials as referenced.
2. MDOT - State of Maine Department of Transportation, Standard Specifications for Highways and Bridges (Latest Edition) as referenced.
3. AASHTO – American Association of State Highway and Transportation Officials

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Structural Base Course: Course supporting the concrete footings and slabs-on-grade.

F. Subbase Course: Course placed between the subgrade and base course for asphalt and concrete pavement, or course placed between the subgrade and a concrete footings and slabs.

G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed and authorized by Owner's Representative. Such authorized excavation and replacement material will be paid for according to arrangements with Owner's Representative.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction and authorization by Owner's Representative. Unauthorized excavation, as well as remedial work directed by Owner's Representative, shall be without additional compensation.

H. Fill: Soil materials used to raise existing grades.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Each type of plastic warning tape.
2. Geotextile.
3. Controlled low-strength material, including design mixture.
4. Geofoam.

B. Samples: 12-by-12-inch (300-by-300-mm) Sample of geotextiles.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 1557 for each on-site and borrow soil material proposed for fill and backfill.

1.5 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Owner will retain an independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt any utilities unless permitted in writing by Owner's Representative and or the applicable utility provider and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify Owner's Representative and applicable utility provider not less than five days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's Representative and applicable utility provider written permission.
3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

C. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult the Owner's Representative and the applicable utility provider immediately for directions. Cooperate with Owner and utilities companies in keeping respective services and facilities in operation. Repair all damaged utilities to satisfaction of Utility Owner.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from on-site excavations.

2.2 SOIL MATERIALS FOR ROADWAYS AND PARKING LOTS

A. Aggregate Subbase Material: Naturally or artificially graded mixture of crushed gravel, crushed stone, and natural or crushed sand which are free from vegetable matter, lumps, or balls of clay, and other deleterious substances with no particles of rock that will not pass the 4-in. square mesh sieve. The gradation of the portion which will pass a 3-inch sieve shall meet the grading requirements of MDOT 703.06 (b) Type D.

B. Aggregate Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand which are free from vegetable matter, lumps or balls of clay, and other deleterious substances. The gradation of the base materials shall meet the grading requirements of MDOT 703.06(a) Type A – Crushed.

2.3 SOIL MATERIALS FOR STRUCTURES

A. See Geotechnical report by Summit Geoengineering dated January 2012.

2.4 PIPE BEDDING MATERIALS

A. Granular Pipe Bedding Material: Shall be clean and free of organic matter, silt, or clay lamps, and deleterious materials. The material shall meet the following graduation requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieve
1/2 inch	100
No. 4	95-100
No. 40	20-45
No. 200	0-5

B. Crushed Stone Pipe Bedding Material: Shall be screened or crushed stone free of organic matter, silt, or clay lumps, and deleterious material. The material shall meet the following graduation requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieve
3/4 inch	100
1/4 inch	0-5

2.5 UNDERDRAIN MATERIALS

A. Crushed Stone: Shall meet crushed stone requirements above.

2.6 ON-SITE MATERIALS

A. Material on the site is the property of the Owner and shall be incorporated in the work if possible. The Owner's Representative shall classify the material under Article 2.01 headings. Any sample testing needed for this classification will be performed by an approved laboratory at the Owner's expense.

B. Material not incorporated in the work will be hauled away and disposed of at the Contractor's expense.

1. Material designated to be wasted by the Owner's Representative will be disposed of by the Contractor.
2. Material designated to be saved by the Owner's Representative will be stockpiled at a location shown on the drawings or designated by the Owner's Representative.
3. Unsuitable material shall consist of grubbings or other materials which contain rock of size exceeding specifications, organic materials, or other materials of a deleterious nature as deemed by the Owner's Representative.

2.7 MISCELLANEOUS MATERIALS

A. Common Borrow: Shall be earth and shall be free of frozen material, perishable rubbish, peat, organic matter, large rock fragments, or other unsuitable material. AASHTO M145 “The classification of soils and soil aggregate mixtures for highway construction purposes AASHTO Designation M145-82 Part 1 Specifications latest edition Classifications A-1 through A-3 may be used. Use of other materials as common borrow is at the discretion of the Owner's Representative and only in approved areas.

B. Granular Borrow: Shall consist of uniformly graded granular material having no rocks with a maximum dimension of over 6 in. and that portion passing a 3-in. square mesh sieve shall contain not more than 70 percent passing a 1/4 - in. mesh sieve and not more than 10 percent passing a No. 200 mesh sieve.

C. Rock Borrow: Shall consist of hard durable rock broken to various sizes that will form a compact embankment with a minimum of voids. The maximum size for any rock shall be 3 feet in its greatest dimension.

D. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.

E. Underdrain material: The material surrounding an underdrain or foundation drain pipe which shall be the same as pipe crushed stone pipe bedding material indicated above.

F. Impervious Borrow: Clayey gravel and sand mixture capable of compacting to a dense state.

G. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.

H. Topsoil: Shall be in accordance with Division 31 Section “Turf and Grasses.”

I. Satisfactory Excavated Material (Onsite): Shall conform to the requirements of the material it is to be used for as determined by the Owner's Representative and be of an appropriate water content to facilitate obtaining the required compaction.

2.8 GEOTEXTILES

A. Refer to the drawings for geotextile fabrics.

2.9 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:

B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing" and Division 32 “Turf and Grasses.”

C. Protect and maintain erosion and sedimentation controls, as specified herein and as noted on the drawings during earthwork operations.

D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system, specified in Division 31 Section "Dewatering," as necessary to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Use of Explosives: Do not bring explosives onto site or use in work without prior written permission from the Owner's Representative and authorities having jurisdiction. Contractor is solely responsible for handling, storage, and use of explosive materials when their use is permitted.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials do not meet the specification requirements for fill and backfill materials remove said materials from site and replace with satisfactory soil materials.
   a. Remove rock to the limits indicated in Division 31 Section "Rock Removal

B. Excavation of Unsuitable Material: Excavate and remove all fill materials including loose, uncompacted soils material, buried vegetation and other organic or inorganic debris shown on the plans, encountered during the prosecution of the work, or as directed by the Owner's Representative. The excavation shall extend to the limits and depth necessary to remove all fill and unsuitable native material.

C. Muck Excavation: Excavate and dispose of saturated and unsaturated mixtures soils and organic matter not suitable for foundation or embankment material, regardless of moisture content.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1/2 inch (13 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand or use smooth bladed equipment to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work. Limit equipment and worker traffic on the finished bearing surfaces to maximum extent possible.
2. Pile Foundations: Stop excavations 6 to 12 inches (150 to 300 mm) above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades, within a vertical tolerance of one (1) in.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations, within a vertical tolerance of one (1) in.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: Excavate to the uniform width shown or required for the particular item to be installed. Provide adequate working space for compactive equipment.

C. Trench Bottoms without bedding course: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 4 inches (150 mm) in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 4 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
3. When rock or other unyielding bearing material is encountered excavate trench 6 inches (150 mm) below bottom of pipe and backfill with crushed stone or gravel or other approved material prior to installing pipe.

D. Trench Bottoms with bedding course: Excavate trenches as necessary to allow for installation of bedding course.
1. Excavate bottom trench to limit required to install thickness of bedding material indicated, typically 6 inches below outside diameter of pipe.

2. When rock or other unyielding bearing material is encountered excavate trench 6 inches (150 mm) below bottom of bedding course and backfill with crushed stone or gravel or other approved material prior to installing pipe.

3.8 SUBGRADE INSPECTION

A. Notify Owner's Representative when excavations have reached required subgrade.

B. If Owner's Representative determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed. Such additional excavation shall be considered "Authorized"

C. Proof-roll subgrade below the building slabs or pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes) or with a minimum of four passes of a self propelled vibratory roller.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner's Representative, and replace with compacted backfill or fill as directed.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Owner's Representative, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Owner's Representative.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Owner's Representative.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees. Locations to be approved by Owner's Representative.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting and backfilling of voids with satisfactory materials. Temporary sheet piling driven below bottom of structures shall be removed in manner to prevent settlement of the structure or utilities, or cut off and left in place if required.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Trench excavations in public streets and other confined areas where trench walls cannot be sloped must be supported by sheeting, shoring, or other methods acceptable to meet the requirement that the Contractor provide inspection of excavations.

B. In pipe trenches, use material specified in typical trench section.

C. Place backfill on subgrades free of mud, frost, snow, or ice.

D. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

E. Controlled Low-Strength Material (Flowable Fill): Place initial backfill of controlled low-strength material to a height of 12 inches (300 mm) over the utility pipe or conduit.

F. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

G. Place and compact final backfill of satisfactory soil to final subgrade elevation.

H. Controlled Low-Strength Material (Flowable Fill): Place final backfill of controlled low-strength material to final subgrade elevation.

I. Install warning tape directly above utilities (water, sewer, gas, steam, and electrical line3), 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use acceptable excavated or borrow material.

2. Under walks and pavements, use material specified in the typical pavement section.
3. Under steps and ramps, aggregate subbase material.
4. Under building slabs, use structural fill material.
5. Under footings and foundations, use structural fill material.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten subgrade and each subsequent fill or backfill soil layer in proper quantities to prevent free water appearing on surface during or subsequent to compaction operations to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 12 inches (300 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 6 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit density according to ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Adjacent to Structures: Compact each layer of backfill or fill soil materials at 95 percent.
3. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95 percent.
4. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 90 percent.
5. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent in unpaved areas and 95 percent in paved areas.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch (25 mm).
2. Walks: Plus or minus 1/2 inch (13 mm).

C. Grading Inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.17 SUBSURFACE DRAINAGE

A. Refer to Division 33 Section "Subdrainage."

3.18 PAVEMENT SUBBASE AND BASE COURSES

A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase and base course under pavements and walks as follows:

1. Install separation geotextile, if indicated, on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape subbase and base course to required crown elevations and cross-slope grades.
4. Place subbase and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
5. Place subbase and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
6. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.19 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Owner’s Representative.

D. Testing agency will test compaction of soils in place according to ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), ASTM D 2922 (Nuclear Device), as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than 3 tests. In each compacted fill layer, make one field density test for every 2000 sq. ft. of overlaying building slab or paved area, but in no case less than 3 tests
2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet (30 m) or less of wall length, but no fewer than 2 tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet (46 m) or less of trench length, but no fewer than 2 tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Owner’s Representative; reshape and recompact.

C. Where settling occurs before end of warranty period, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to extent possible and as acceptable to the Owner’s Representative at no additional cost.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Drawing: C-300 “Erosion & Sedimentation Control” Details and Notes apply to this section.

1.2 SUMMARY

A. This Section includes the following:

1. Installation of siltation and erosion control facilities.
2. Provide temporary seeding, mulching, or other protective coverings.

B. Related Specifications include on the following:
1. Division 02 Section “Site Demolition” for removal of structures, site improvements, landscaping features and utilities.
2. Division 31 Section “Site Clearing” for clearing and grubbing and stockpiling of existing materials.

3. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
4. Division 31 Section "Dewatering" for dewatering of excavations.

C. References:

1. MDEP – Maine State Department of Environmental Protection.
2. MDOT - State of Maine Department of Transportation Standard Specifications for Highways and Bridges (Latest Edition).

1.3 SEDIMENTATION CONTROL GUIDELINES

A. Maine DEP Erosion and Sediment Control Handbook for Construction: Best Management Practices. MDEP, latest edition.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials incorporated in erosion control shall be specified in other sections or included herein.

2.2 SILTATION FENCE

A. Siltation Fence: 30 inch high, fence consisting of synthetic filter fabric reinforced with a supporting mesh and mounted on wood or metal stakes.

1. Fabric: Pervious sheet of synthetic polymer such Mirafi 100X or equivalent

2. Post: Rolled steel manufactured line post or 2 inch diameter hardwood post, 4.5 feet in length.

2.3 FILTER BERM

A. Filter Berm: A windrow of erosion control soil mix a minimum of 12 inches high by 24 inches wide.

2.4 GRASS SEED MIXTURE FOR EROSION CONTROL

A. Grass seed mixture for both temporary and permanent control shall be in accordance with the MDEP requirements.

2.5 EROSION CONTROL BLANKET

A. Place on newly loamed and seeded areas as indicated on the Contract Drawings. The matting shall be Curlex Excelsior Blanket manufactured by Amxco, Hold/Gro Erosion Control Fabric as manufactured by Gulf States Paper Corporation, Jute Mesh as manufactured by Ludlow, or an approved equivalent.

2.6 HAY BALES

A. Hay Bales: Bales shall be at least 14" x 18" x 30" in size, staked twice per bale. Stakes shall be 1" x 1" x 36" wooden. Place bales with twine on sides of bale, not top and bottom.

2.7 MULCH

A. Mulch: Cured hay free from primary noxious weed seeds and rough or woody materials.

PART 3 - EXECUTION

3.1 PREPARATION

A. Review site erosion control plan.

B. Deficiencies or changes in the erosion control plan as it is applied to current conditions will be brought to the attention of the Owner's Representative for remedial action.

3.2 GENERAL INSTALLATION

A. The Contractor shall provide for the diversion of surface water from the construction areas and install siltation and erosion control structures.

B. The Contractor shall build all drains, dikes, sediment basins, install all siltation fencing, mulches, grasses, seeding, ditches, channels, riprap, grading, and all other work necessary to control water pollution, surface runoff, and soil erosion.

C. The Contractor shall provide temporary seeding, mulching, or other protective coverings to exposed earth surfaces or stockpiles which will be exposed to rain or wind elements through the fall and winter seasons.

D. The Contractor shall maintain all facilities necessary to control water pollution, surface runoff, and soil erosion until permission is given by the Owner's Representative to discontinue the use of the facilities.

3.3 SILT FENCE

A. Silt Fence: Set fence post 8 feet O.C. to a depth of 2 feet. Attach support fence to post with fencing staples or appropriate wire ties. Overlap joints in support fence 12 inches. Apply fabric to full height of support fence and secure to prevent sagging, blow off, and loss. A 12-inch overlap of fabric for vertical piecing shall be maintained, folded to a 3 inch width and securely attached to supports. No horizontal joints will be allowed. The bottom of the fabric shall be trenched into the existing ground a minimum of 6 inches. In addition, hay bales or ditch checks shall be installed along the silt fence to create sedimentation pools in low areas where run-off concentrates. All silt fence to be removed by the Contractor when no longer required for temporary erosion and sedimentation control.

3.4 FILTER BERM

A. Filter Berm: Place uncompacted erosion control mix in a windrow at locations shown on the plan or as directed by the Owner's Representative. At a minimum the berm shall be 3 feet wide at the base and 2 feet high at the center of all points along its length. Berm material, where the berm is still required, which has decomposed, clogged with sediment, eroded, or becomes ineffective, shall be replaced. The berm shall be removed from the site when no longer required, as determined by the Owner's Representative.

3.5 TEMPORARY SEEDING AND MULCHING

A. Topsoil stripped and stockpiled on site shall be immediately seeded with erosion control seed mix and mulched with hay.

B. Exposed earthwork areas, which will not be worked on for one week, shall be hay mulched. Unfinished areas which are not to be worked on for one month, or will be wintered, shall be seeded with erosion control mix at a rate of 4 pounds of seed per 1000 sq. ft. and mulched with hay. Apply hay mulch at the rate of 3 tons per acre such that no soil is exposed. Anchor mulch to prevent wind blown movement.

C. In sensitive areas (within 25 ft. of stream or wetland edge) temporary mulch must be applies within 7 days of initial disturbance and prior to any storm event.

D. Winter Mulch: If the catch of grass is less than 75% by November 15, apply additional hay mulch to achieve a protective layer of 5 tons per acre. Anchor mulch with mesh to prevent wind blown movement.

E. No fill shall be placed on hay mulch. Dispose of used hay mulch off site.

3.6 DRAINAGE DITCHES AND EMBANKMENTS

A. Drainage ditches shall be provided with filter berm silt dams or rock check dams spaced no greater than 100 feet apart.

1. Temporary ditch dams shall be constructed where indicated, using composted bark soil mix or rocks in the configurations shown. Additional temporary ditch dams shall be installed from time to time during the construction where necessary to prevent soil particle migration from the work area. Where necessary due to terrain configuration, earth berms shall be constructed at one or both ends of the ditch check so as to contain runoff. The tops of earth berms shall be higher than the tops of the dams so that runoff will occur only over the dams. Sand bags may be used instead of earth berms at the Contractor's option but shall be faced with earth placed against the upstream face.

B. Drainage ditches and swales shall be lined with a continuous matt of erosion control mesh for full bottom width and side slopes to 12" above bottom.

C. Where erosive velocities in ditches or embankments are anticipated or experienced, and soil cannot be stabilized with mulch and mesh alone, substitute erosion control soil mix in place of loam. For this use, screen erosion control soil mix to remove wood, bark, and stones one-inch in size and greater.

D. Stabilize pond embankments (interior and exterior), slopes steeper than 3 horizontal to one vertical, and drainage ditches by October 1. Stabilization shall consist of permanent seeding and mulch, temporary winter seeding (winter rye) and winter mulch, or rip-rap.

E. Erosion control mesh shall be installed on slopes steeper than 6 horizontal to one vertical (16%) and in conformance to MDOT Standard Specifications, latest Edition, Section 9.48, paragraphs 613.03 through 613.06. Anchor mesh as recommended by manufacturer.

3.7 PARKING AND DRIVES

A. Place temporary stabilized construction exits at all locations where vehicles leave the site and enter existing paved roads and as indicated on the drawings; consisting of a 6" layer of 1-1/2" to 3" crushed stone. Tracking and spilling of earth and/or debris on public streets shall be avoided to the maximum extent possible. The Contractor is responsible for all clean up and removal of such spillage.

B. As soon as possible after roads and parking areas are cleared, grubbed and graded to the required subgrade, the gravel base shall be placed.

3.8 REMOVAL OF TEMPORARY CONTROL MEASURES

A. As soon as slopes, roadways, ditches and other areas are complete and stabilized all temporary measures shall be removed from the site.

END OF SECTION

SECTION 31 50 00

LATERAL SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes temporary excavation support and protection systems where indicated on the drawings, where directed by the Owner's Representative for protection of structures and where required to meet safety requirements of the U.S. Department of Labor's Construction Safety Act designated as Title 29-LABOR-Part 1926 Safety and Health Regulations for Construction, Subpart P, Sections 926.650 through 653.

B. Trench excavations in public streets and other confined areas where trench walls cannot be sloped must be supported by sheeting, shoring, trench boxes, or other methods acceptable to meet the requirement that the Contractor provide inspection of excavations.

C. Related Specifications included in the following:

1. Division 02 Section “Geotechnical Investigations” for assistance in the design of excavation supports.
2. Division 31 Section “Earth Moving”.

D. References:
1. ASTM- American Society for Testing & Materials as referenced.
2. OSHA - Occupational Safety and Health Administration.

1.3 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed loads.

1. Design excavation support and protection system, including comprehensive engineering analysis by a qualified State of Maine professional engineer, to meet site conditions.
2. Prevent surface water from entering excavations by grading, dikes, or other means.
3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
4. Monitor vibrations, settlements, and movements.

5. In accord with OSHA Standards and Interpretations: Subpart P - Excavations, Trenching, and Shoring, current edition.

1.4 SUBMITTALS

A. Shop Drawings: For excavation support and protection system. Submit sealed plans at least ten (10) days prior to beginning related construction.

1.5 PROJECT CONDITIONS

A. Project-Site Information: A geotechnical report has been prepared for this Project, refer to Division 02 Section "Geotechnical Investigations". The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.

1. Make additional test borings and conduct other exploratory operations necessary for the design and installation of excavation support and protection system as necessary.

PART 2 - EXECUTION

2.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.

D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

2.2 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches (1200 mm) below overlaying construction and abandon remainder.
2. Fill voids immediately with approved backfill compacted to density specified in Division 31 Section "Earth Moving."
3. Repair or replace, as approved by Owner's Representative, adjacent work damaged or displaced by removing excavation support and protection systems.

B. If indicated on the drawings, leave excavation support and protection systems permanently in place.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Hot-mix asphalt patching.
   2. Hot-mix asphalt paving.

B. Related Work Specified Elsewhere:

   1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
   2. Maine Department of Transportation (MDOT) Standard Specification, latest edition.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

   1. Submit laboratory test reports of the stockpiled aggregates initially used in the mix and additional test reports for each change of source per MDOT Section 401.
   2. Submit laboratory test reports for asphalt cement used in the initial mix and additional test reports for each change of source per MDOT Section 401.
   3. Job-Mix Designs: Certification, by MDOT, of approval of each job mix proposed for the Work per MDOT Section 401.

B. Samples: For the following products, in manufacturer's standard sizes unless otherwise indicated:

C. Qualification Data: For qualified manufacturer.

D. Material Test Reports: For each paving material.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by the Maine Department of Transportation.

B. Installer Qualifications: Imprinted-asphalt manufacturer's authorized installer who is trained and approved for installation of imprinted asphalt required for this Project.

C. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

D. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Maine Department of Transportation Standard Specifications for asphalt paving work.

1.5 PROJECT CONDITIONS

A. For weather limitations the State will be considered to be divided into 2 paving zones.

1. Zone 1 – All area north of U.S. Route 2 from Gilead to Bangor and north of Route 9 from Bangor to Calais.
2. Zone 2 – All area south of Zone 1 including the U.S. Route 2 and Route 9 boundaries.

B. Hot Mix Asphalt Pavement (HMA) for use other than traveled way, wearing course may be placed in either zone between the dates of April 15th and November 15th, provided that the air temperature as determined by an approved thermometer (placed in the shade at the paving location) is 40°F or higher and the area to be paved is not frozen.

C. Hot Mix Asphalt Pavement (HMA) to be placed as traveled way, wearing course may be placed in Zone 1 between the dates of May 1st and the Saturday following October 1st and in Zone 2 between the dates of April 15th and the Saturday following October 15th provided the air temperature determined as above is 50°F or higher. The traveled way as used herein shall also truck lanes, ramps, approach roads and auxiliary lanes.

D. Hot bituminous mixtures used for curb, driveways, sidewalks, islands or other incidentals are not subject to season limitations, except that weather conditions shall be satisfactory for proper handling and finishing of the mixture. Unless otherwise specified, bituminous plant mix shall not be placed on a wet surface or a frozen surface. The air temperature shall be 40°F or higher.

E. When it is in the public interest for service to traffic, the Owner's Representative may authorize construction of Hot Mix Asphalt Pavements at lower atmospheric temperatures than those specified or extend the dates of the paving season.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The materials and their use shall conform to the requirements of Section 401 – Hot Mix Asphalt Pavement of the MDOT Standard Specifications.

2.2 AUXILIARY MATERIALS

A. Sand: AASHTO M 29, Grade Nos. 2 or 3.

B. Joint Sealant: AASHTO M 324, Type IV, hot-applied, single-component, polymer-modified bituminous sealant.

2.3 MIXES

A. The materials and their use shall conform to the requirements of Section 401 – Hot Mix Asphalt Pavement of the MDOT Standard Specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction[, repeating proof-rolling in direction perpendicular to first direction]. Limit vehicle speed to 3 mph (5 km/h).
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

3.2 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.3 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch (6 mm).

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.

3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.5 HOT-MIX ASPHALT PLACING

A. The construction requirements shall be as specified in Section 401 – Hot Mix Asphalt Pavement of the MDOT Standard Specifications.

3.6 INSTALLATION TOLERANCES

A. Per MDOT Standard Specifications.

3.7 FIELD QUALITY CONTROL

A. General: Comply with requirements of the MDOT Standard Specifications.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be as indicated on the drawings and determined according to ASTM D 3549.

D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

E. In-Place Density: Testing agency will take samples of (cores) taken from the in-place, compacted pavement indicating the percentage of theoretical maximum density (TMD), based on laboratory specimens of the mix combined in the proportions of the job mix formula.

1. Asphalt Pavement Density: Submit laboratory test reports at frequencies not less than one of the following:

a. Every 150 Mg placed.
b. Each day's placement.
c. Each course, each day's placement.

F. Replace and compact hot-mix asphalt where core tests were taken.

G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.8 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow milled materials to accumulate on-site.

END OF SECTION

SECTION 32 14 00

UNIT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Concrete pavers set in aggregate setting beds.
2. Edge restraints.

B. Related Sections:

1. Division 31 Section "Earth Moving" for excavation and compacted subgrade.

C. References:
1. ASTM- American Society for Testing & Materials.
2. MDOT - State of Maine Department of Transportation - Standard Specifications for Highways and Bridges, latest edition.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Pavers.
2. Edge restraints.

B. Samples: For the following:

1. Each type of unit paver indicated.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from one source with resources to provide materials and products of consistent quality in appearance and physical properties.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

1.6 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

PART 2 - PRODUCTS

2.1 CONCRETE PAVERS

A. Concrete Pavers: Solid interlocking paving units complying with ASTM C 936 and resistant to freezing and thawing when tested according to ASTM C 67, made from normal-weight aggregates.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Trevia tumbled paver as distributed by Genest Concrete Products.
b. Approved substitute.

2. Thickness: 2-3/8 inches (60 mm).
3. Face Size and Shape: As indicated on Drawings
4. Color: As indicated on the plans

2.2 ACCESSORIES

A. Plastic Edge Restraints: Triangular PVC extrusions 1-3/4 inches (45 mm) high by 3-1/2 inches (89 mm) wide designed to serve as edge restraints for unit pavers; rigid type for straight edges and flexible type for curved edges, with pipe connectors and 3/8-inch (9.5-mm) diameter by 12-inch- (300-mm-) long steel spikes.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. BRICKSTOP Corporation.
b. PAVE TECH Inc.; Pave Edge.
c. Snap Edge Corporation; Snap Edge.

2.3 AGGREGATE SETTING-BED MATERIALS

A. Sand for Leveling Course: As per the drawings.

B. Sand for Joints: Polymeric sand as per the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Base Approval: Contractor shall examine the base to determine its adequacy to receive concrete pavers on sand/stone dust setting bed or concrete pavers and bituminous setting bed. The base shall be compacted in three inch lifts at optimum moisture density of at least 95%. Gravel base course shall extend for a distance of at least 6" beyond pavement edge.

C. Start of work of this Section shall constitute acceptance of paved base.

3.2 PREPARATION

A. Proof-roll prepared subgrade according to requirements in Division 31 Section "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive base course for unit pavers.

3.3 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

D. Joint Pattern: Provide the following joint pattern.
1. As indicated on the drawings.

E. Tolerances: Do not exceed 1/16-inch (1.6-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches (3 mm in 600 mm) and 1/4 inch in 10 feet (6 mm in 3 m) from level, or indicated slope, for finished surface of paving.

F. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.

1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.

3.4 AGGREGATE SETTING-BED APPLICATIONS

A. Compact soil subgrade as required in Division 31 Section "Earth Moving".

B. Install gravel base and compact to 95% as required.

C. Place leveling course and screed to a thickness of 1 inche (25 to 38 mm), taking care that moisture content remains constant and density is loose and constant until pavers are set and compacted.

D. Set pavers butt tight being careful not to disturb leveling base. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch (10 mm) with pieces cut to fit from full-size unit pavers.

E. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf (16- to 22-kN) compaction force at 80 to 90 Hz. Perform at least three passes across paving with vibrator. Vibrate under the following conditions:

1. After edge pavers are installed and there is a completed surface or before surface is exposed to rain.

2. Before ending each day's work, fully compact installed concrete pavers to within 36 inches (900 mm) of the laying face. Cover pavers that have not been compacted, and leveling course on which pavers have not been placed, with nonstaining plastic sheets to protect them from rain.

F. Spread polymeric sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

G. Do not allow traffic on installed pavers until sand has been vibrated into joints.

H. Repeat joint-filling process 30 days later.

3.5 REPAIRING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

END OF SECTION

SECTION 32 16 19

ASPHALT CURBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Asphalt curbing.

B. Related Sections include the following:

1. Division 31 Section "Earth Moving" for excavation and compacted subgrade.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Submit laboratory test reports of the stockpiled aggregates initially used in the mix and additional test reports for each change of source per MDOT Section 401.
2. Submit laboratory test reports for asphalt cement used in the initial mix and additional test reports for each change of source per MDOT Section 401.
3. Job-Mix Designs: Certification, by MDOT, of approval of each job mix proposed for the Work per MDOT Section 401.

1.4 QUALITY ASSURANCE

A. State of Maine Department of Transportation (MDOT): Standard Specifications for Highways and Bridges (Latest Edition).

1.5 PROJECT CONDITIONS

A. Hot bituminous mixtures used for curb or other incidentals are not subject to season limitations, except that weather conditions shall be satisfactory for proper handling and finishing of the mixture. Unless otherwise specified, bituminous plant mix shall not be placed on a wet surface or a frozen surface. The air temperature shall be 40°F or higher.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The materials and their use shall conform to the requirements of Section 401 – Hot Mix Asphalt Pavement of the MDOT Standard Specifications.

2.2 MIXES

A. The materials and their use shall conform to the requirements of Section 401 – Hot Mix Asphalt Pavement of the MDOT Standard Specifications.

PART 3 - EXECUTION

3.1 ASPHALT CURBS

A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread mix at minimum temperature of 250 deg F (121 deg C).

1. Asphalt Mix: Same as pavement surface-course mix.

B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.2 PROTECTION

A. Protect the curb and keep in good condition. Clean all exposed surfaces smeared or discolored and restored to a satisfactory condition or the curb removed and replaced.

END OF SECTION

SECTION 32 16 40

GRANITE CURBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Granite curbing.

B. Related Sections include the following:

1. Division 31 Section "Earth Moving" for excavation and compacted subgrade.

C. References:
1. ASTM- American Society for Testing & Materials.
2. MDOT - State of Maine Department of Transportation - Standard Specifications for Highways and Bridges, latest edition.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Granite curbing.

1.4 QUALITY ASSURANCE

A. Per MDOT Standard Specifications.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver curbing to job adequately protected from damage during transit.

B. Protect curbing against staining, chipping and other damage. Cracked, badly chipped, or stained units will be rejected and not employed in the Work.

1.6 PROJECT CONDITIONS

A. Work on Public Ways: Comply with all regulations and requirements of local/state agencies having jurisdiction.

B. Weather Limitations: Comply with requirements in MDOT.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Granite: Provide structural granite conforming to ASTM C 615, Class I Engineering Grade, suitable for curbstone use.

1. Provide material that is light gray, free from seams which impair structural integrity and with percentage of wear less than 32 percent as determined by ASTM C 131.

2.2 GRANITE CURBING

A. Provide curbing complying with MDOT Specifications Section 712.04, Vertical Curb, Type 1 and Sloped Granite Curbing, Type 5, complying with MDOT Material Specifications 712.04.

PART 3 - EXECUTION

3.1 PREPARATION

A. Set curbing in 18-inch wide trench, with trench bottoms at 6 inches below bottom of curb. Fill excavation to required level with base course material conforming to requirements of Division 31 Section “Earth Moving”.

3.2 INSTALLATION

A. Install as indicated on Drawings and except as otherwise specified or indicated in compliance with MDOT 609.03.

B. Set curb with vertical face plumb, curb top parallel to adjacent surface.

C. The required spacing between sections of curb shall be assured by the use of an approved spacing device to provide an open joint between stones of at least 1/4 inch and no greater than 5/8 inch.

D. Set curb accurately to line and grade. Fit units as closely together as possible. Do not field cut curbing.

E. Backfilling: All remaining spaces under the curb shall be filled with approved material and thoroughly hard tamped so the curbing will have a firm uniform bearing on the foundation for the entire length and width. Any remaining excavated areas surrounding the curb shall be filled to the required grade with approved materials. This material shall be placed in layers not exceeding 8 inches in depth, loose measure and thoroughly tamped.

1. Geotextile fabric shall be placed in the back portion of each joint to prevent infiltrating of backfill materials.
2. Reset any curb section disturbed during backfilling or otherwise reset to proper line and grade and properly backfill.

3.3 PROTECTION

A. Protect the curb and keep in good condition. Clean all exposed surfaces smeared or discolored and restored to a satisfactory condition or the curb stone removed and replaced.

END OF SECTION

SECTION 32 17 23

PAVMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pavement-marking paint.

B. Related Sections:

1. Division 32 Section “Asphalt Paving” for paving installation.

1.3 DEFINITION

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS

A. Product Data: Provide data on paint products.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

A. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F (12.8 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with MDOT Specifications, Section 708.03 (Type F).

1. Color: White

2.2 EQUIPMENT

A. Equipment used for the application of pavement striping shall be fully powered and of standard commercial manufacture. Truck mounted equipment may be approved is, in the opinion of the Owner's Representative, the quality of the work of the machine is satisfactory.

PART 3 - EXECUTION

3.1 PREPARATION

A. The use of white and yellow materials will require thorough cleaning of equipment so as not to mix the colors. Any mixture of colors will be deemed sufficient reason for rejection of the work be the Owner's Representative and replacement by the Contractor.

3.2 LAYOUT

A. The transverse lines, established by the Contractor for control of striping, shall be chalked as a guide and shall be approved by the Owner's Representative before the application of any striping. The length of line shall be measured and marked by the Contractor for the locations listed below. All pavement markings shall be in accordance with the applicable sections of the Manual of Uniform Traffic Control Devices for Streets and Highways, most recent addition.

B. Stripe parking lot spaces and any other pavement graphics shown/detailed on Drawings with 4” wide striping. Fire lanes, crosswalks, etc. to be marked as shown on Drawings. The Universal Handicap Symbol, as detailed on Plans, shall be painted at the designated handicapped stalls. The drop-off strips between the handicapped stalls shall be painted solid blue with non-skid surfaces.

3.3 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Owner's Representative.

B. Allow paving to age for 48 hours before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint in accordance with MDOT Standard Specifications, Section 627.

E. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).

1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal. (0.72 kg/L).

3.4 CLEANING

A. If for any reason, paint is spilled or tracked on the pavement, or any markings applied by the Contractor, in the Owner's Representative's judgment, fail to conform to the requirements of this Section, because of a deviation from the desired pattern, the Contractor shall remove such paint by a method that is not injurious to the pavement surface and is acceptable to the Owner's Representative, clean the pavement surface and prepare the surface for a reapplication of markings; and reapply the markings as directed without additional compensation for any of the foregoing corrective operations.

END OF SECTION

SECTION 32 17 29

TRAFFIC SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Parking and Traffic signs.
2. Directional signs.
3. Information signs.

PART 2 - PRODUCTS

2.1 SIGNS

A. Provide signs conforming to the requirements of MDOT standards and section 645 of the MUTCD standards.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in conformance to the requirements of MDOT standards.

END OF SECTION

SECTION 32 92 00

TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Seeding.
2. Hydro-seeding.
3. Sodding.

1.3 DEFINITIONS

A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Planting Soil (Topsoil): Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

E. Sod: Locally grown turf grass sod of species indicated and capable of vigorous growth and development when planted.

F. Subgrade: Surface or elevation of subsoil remaining after excavation is completed, or top surface of a fill or backfill before planting soil is placed.

G. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

H. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 SUBMITTALS

A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.
2. For topsoil, submit topsoil analysis done by a plant and soil testing agency such as the Maine Soil Testing and Analytical Lab (207-581-2934) for review by the Owner's Representative. State recommended quantities for amendments (lime, fertilizer and organic matter) necessary to produce satisfactory topsoil as stated in the specifications herein.
3. Submit product information with mix ratios and amounts for hydro mulching to be used during hydro seeding for Owner's Representative's approval.
4. Submit fertilizer, herbicide and fungicide products for application as required for Owner's Representative's approval.

B. Product Certificates: For soil, soil amendments and fertilizers, from manufacturer.

1.5 QUALITY ASSURANCE

A. Soil-Testing Laboratory Qualifications: An independent laboratory with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

B. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; textural analysis; cation exchange capacity; deleterious material; organic content; pH; and mineral and plant-nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
2. Report suitability of tested soil for turf growth.

a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. (92.9 sq. m) or volume per cu. yd. (0.76 cu. m) for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying. Store in a cool, dry, shaded area.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

D. Use all means necessary to protect seed from moisture and other contaminants which may adversely effect proper germination.

E. Use all means necessary to protect fertilizers, amendments and other materials from moisture and other contaminants which may adversely effect their efficacy.

1.7 PROJECT CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.

1. Spring Planting: April 15 to June 15.
2. Fall Planting: August 15 to October 15.
3. The Contractor may seed at times other than those specified, only upon authorization of the Owner’s Representative.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.8 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is

planted and continue until acceptable turf is established but for not less than the following periods:

1. Seeded Turf: 60 days from date of planting completion.

    a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

2. Sodded Turf: 30 days from date of planting completion.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. Topsoil stockpiled from on-site stripping may be utilized if in compliance with the requirements for new topsoil.

B. New Topsoil:
1. Natural, fertile loam typical of cultivated topsoil of the locality, containing not less than 3.5 percent or more than 8 percent by weight, of decayed organic matter (humus) as determined by ASTM F1647.
2. Obtain from a well drained arable site, free of subsoil, earth clods, large stones, sticks, stumps, clay lumps, roots, or other objectionable, extraneous matter or debris. Screen topsoil to a maximum stone size of 3/4 inch.
3. Provide topsoil that is free of Quack-grass rhizones, *Agropyron Repens*, and the nut-like tubers of Nutgrass, *Cyperus Esculentus*, and all other primary noxious weeds.
4. Provide topsoil with a pH of not less than 6.0 or greater than 6.8.
5. Provide topsoil with a loam texture classification and do not deliver or use while in a frozen or muddy condition.
6. Provide topsoil that conforms to the following particle size distribution, as determined by pipette method in compliance with ASTM F1632.

    a. Sand: 40-60 percent.
    b. Silt: 30-40 percent.
    c. Clay: 5-20 percent.

7. If determined by a soil test the existing topsoil that was stripped does not meet this specifications, the topsoil may be amended to provide and acceptable topsoil for use or replaced by an imported topsoil which conforms to the topsoil specification.

2.2 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species: Seed of grass species as indicated on the drawings and with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

2.3 TURFGRASS SOD

A. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

1. Proportioned by weight as follows:

a. 80 percent Kentucky Bluegrass Minimum (2 varieties minimum).
b. 20 percent Perennial Ryegrass Maximum (2 varieties minimum).

2.4 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: O, with a minimum of 98 percent passing through No. 20 sieve and a minimum of 55 percent passing through No. 60 sieve.
2. Provide lime in form of ground dolomitic limestone.

2.5 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 6.1 to 7.8; moisture content 40 to 60 percent by weight; 100 percent passing through 1/2-inch (12.5-mm) sieve; soluble salt content of less than 2mnho/cm in final topsoil mix; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 30 to 60 percent of dry weight.
2. Nutrients: Provide NPK level information.
3. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with a pH range of 3.4 to 4.8 and an ash content not exceeding 15 percent as determined by ASTM D2974.

2.6 FERTILIZERS

A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 15 percent nitrogen, 15 percent phosphorous, and 15 percent potassium, by weight or as otherwise recommended by the soil analysis.
2. Registration: Fertilizer must be registered with the Maine State Department of Agriculture and shall meet their standard requirements.

2.7 PLANTING SOILS

A. New Planting Soil: Natural, fertile topsoil, with pH range of 6 to 6.8, not less than 3.5 percent or more than 8 percent by weight of organic material content; free of stones 3/4 inch (19 mm) or larger in any dimension and other extraneous materials harmful to plant growth. Mix topsoil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

1. Provide topsoil free of obnoxious weeds and invasive plants including quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.
2. Provide topsoil having a pH of not less than 6.0 or greater tha 6.8.
3. Do not deliver or use while in a frozen or muddy condition.
4. Topsoil shall conform to the following particle size distribution, as determined by pipette method in compliance with ASTM F-1632:

    a. Sand: 40 to 60 percent.
    b. Silt: 30 to 40 percent.
    c. Clay: 5 to 20 percent.

B. Existing Planting Soil: Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

1. Supplement with new planting soil when quantities are insufficient.
2. Mix existing, native surface topsoil with soil amendments and fertilizers to produce planting soil equal to new planting soil.
3. If determined by a soil test the existing topsoil that was stripped does not meet the specification for new planting soil, the topsoil may be amended to provide an acceptable topsoil for use or replaced by an imported topsoil which conforms to the new planting soil specification.

2.8 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley. No material shall be used which is too wet, decayed or compacted as to inhibit even uniform spreading.

B. Fiber Mulch: Biodegradable, green dyed wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5. Provide in moisture resistant sealed bags marked with the manufacturer's name, the air dry weight and composition of the contents.

C. Hydro mulch: Shall be Terra-Sorb GB, or an approved equal. Add Terra-Sorb to the hydro seed tank at the amount of 60 pounds per acre.

D. Mulch Binder: Asphalt emulsion; ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydro-seeding and hydro-mulching overspray.
2. Protect grade stakes set by others until directed to remove them.

3.3 TURF AREA PREPARATION

A. Limit turf subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.

a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
b. Mix lime with dry soil before mixing fertilizer.

2. Spread planting soil to a minimum depth of 6 inches (150 mm), unless noted otherwise, but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:

1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least 6 inches (150 mm). Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches (100 mm) of soil. Till soil to a homogeneous mixture of fine texture.
3. Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Before planting, obtain Owner’s Representative acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

G. Provide fertilizer and lime application if recommended by the soil testing lab. Apply with broadcast spreader and incorporate into the top 4 inches of topsoil.

3.4 SEEDING

A. Method of seeding may be varied at discretion of Contractor. It is his or her responsibility to establish a smooth, uniform turf composed of approved grasses.

B. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.
2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

C. Sow seed at rate recommended by the supplier.

D. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.

E. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.

F. Mulch seeded areas with straw mulch, 1-1/2 to 2 tons per acre. Secure mulch at Contractor's discretion as to method or need.

3.5 HYDRO-SEEDING

A. Method of seeding may be varied at discretion of Contractor. It is his or her responsibility to establish a smooth, uniform turf composed of approved grasses.

B. Hydro-seeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydro-seed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with asphalt-emulsion tackifier.
2. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre (5.2-kg/92.9 sq. m) dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1400 lb/acre.

3.6 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across angle of slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.7 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and additional mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
4. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
5. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.

B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain a grass height of 2-1/2 to 3 inches.

3.8 INSPECTION AND ACCEPTANCE

A. Turf installations shall meet the following criteria as determined by Owner's Representative. The Owner's Representative will inspect lawns upon written request by the Contractor. The request shall be received at least ten (10) days before the anticipated date of inspection.

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).
2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

C. If the grass is in satisfactory condition, the Contractor's care and maintenance responsibilities will end. If the grass stand is unsatisfactory, the Contractor's maintenance responsibility shall continue, including a normal program of mowing, trimming, reseeding, fertilization and repair until and acceptable stand of grass is achieved.

3.9 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

C. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION

SECTION 32 93 00

PLANTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plants.
2. Planting soils.
3. Tree stabilization.

B. Related Sections:

1. Division 31 Section "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
2. Division 31 Section "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
3. Division 32 Section "Turf and Grasses" for turf (lawn) and roadway planting, hydro-seeding, and erosion-control materials.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than sizes indicated; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than sizes indicated.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when

removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Finish Grade: Elevation of finished surface of planting soil.

G. Planting Area: Areas to be planted.

H. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

I. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

J. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

K. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

L. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

M. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

N. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 SUBMITTALS

A. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

B. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

C. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

B. Plant Material Observation: Owner's Representative may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Owner's Reprsentative retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Owner's Representative of sources of planting materials seven days in advance of delivery to site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

C. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.

G. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.

4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

C. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.8 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
b. Structural failures including plantings falling or blowing over.
c. Faulty performance of tree stabilization, edgings, or tree grates.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods from Date of Acceptance: 12 months.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. Provide extended warranty for period equal to original warranty period, for replaced plant material.

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: Until date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots will be rejected.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Owner's Representative, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

E. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery.

2.2 FERTILIZERS

A. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 10-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 PLANTING SOILS

A. Refer to Division 32 Section “Turf and Grasses” for topsoil requirements and plans for planting soil mix.

2.4 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Aged spruce and pine bark, consisting of the outer bark of the trees with minimum hardwood bark. Bark shall be thoroughly mixed and aged in stock piles a minimum of 6 months, partially decomposed, dark brown in color, and generally free of chunks of wood thicker than 1/4". Aged mulch containing an excess of fine particles will not be acceptable.

2.5 TREE STABILIZATION MATERIALS

A. Stakes and Guys:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated, pointed at one end.
   a. Guying: 30 inches long.
   b. Staking: 96 inches long.
2. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 14 gage in diameter, with rubber hose or Chain Lock brand plastic tree tie or approved equivalent. Install only when required by site conditions.
3. Wrapping Material: First quality, heavy, waterproof crepe paper manufactured for this purpose; not less than 4" wide. Install only when required or as noted on the drawings.

B. Root-Ball Stabilization Materials:

1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated; stakes pointed at one end.
2. Wood Screws: ASME B18.6.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Owner’s Representative acceptance of layout before excavating or planting. Make minor adjustments as required.

C. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 PLANTING AREA ESTABLISHMENT

A. Loosen subgrade of planting areas to a minimum depth of 12 inches (300 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Spread planting soil to a depth of 12 inches (300 mm) unless indicated or directed otherwise but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

C. Before planting, obtain Owner's Representative acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

D. Application of Mycorrhizal Fungi: Apply as required for best plant growth.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits as indicated on the Drawings.

B. Subsoil and topsoil removed from excavations may be used as planting soil if determined suitable for site conditions and plant selections.

C. Obstructions: Notify Owner's Representative if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

D. Drainage: Notify Owner's Representative if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare as indicated to adjacent finish grades.

1. Use planting soil as specified on the drawings.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 TREE, SHRUB, AND VINE PRUNING

A. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Owner's Representative, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

B. Do not apply pruning paint to wounds.

3.7 TREE STABILIZATION

A. Install trunk stabilization when indicated on the Drawings as follows:

1. Upright Staking and Tying: Stake trees of 2- through 5-inch (50- through 125-mm) caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation. Set vertical stakes and space to avoid penetrating root balls or root masses.
2. Use two stakes for trees up to 12 feet (3.6 m) high; three stakes for trees less than 14 feet (4.2 m) high and greater than 2-1/2 inches (63 mm) in caliper. Space stakes equally around trees.
3. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

3.8 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicted on the drawing in even rows with triangular spacing for review by Owner's Representative.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.9 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

3.10 EDGING INSTALLATION

A. Wood Edging: Install edging where indicated on the drawings. Fasten each cut joint or connection with two galvanized nails. Anchor with wood stakes spaced up to 36 inches (900 mm) apart, driven at least 1 inch (25 mm) below top elevation of edging.

B. Steel Edging: Install steel edging where indicated on the drawings according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches (760 mm) apart, driven below top elevation of edging.

C. Aluminum Edging: Install aluminum edging where indicated on the drawings according to manufacturer's written instructions. Anchor with aluminum stakes spaced approximately 36 inches (900 mm) apart, driven below top elevation of edging.

D. Plastic Edging: Install plastic edging where indicated on the drawings according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 36 inches (900 mm) apart, driven through upper base grooves or V-lip of edging.

E. Shovel-Cut Edging (turf cut edge): Separate mulched areas from turf areas, curbs, and paving with a 45-degree, 4- to 6-inch- (100- to 150-mm-) deep, shovel-cut edge as shown on Drawings.

3.11 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated past management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.12 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply only as directed to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.13 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.14 DISPOSAL

A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION

SECTION 33 05 15

CATCH BASINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes storm drainage structures outside the building, with the following components:

1. Catch basins.

B. Related Sections include the following:

1. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
2. Division 31 Section "Lateral Support and Protection" for protection of excavations.

1.3 SUBMITTALS

A. Shop Drawings: For the following:

1. Catch Basins: Include plans, elevations, sections, details, and frames, covers, and grates.

B. Field quality-control test reports.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Handle catch basins according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 CATCH BASINS

A. Standard Precast Concrete Catch Basins: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints per the following, unless indicated otherwise on the drawings.

1. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
2. Riser Sections: 4-inch (102-mm) minimum thickness, and lengths to provide depth indicated.
3. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
4. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber. Approved lubricant shall be applied over the inside tongue and over the rubber gasket immediately prior to setting one section on top of another if "O"-Ring joints are used.
5. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
6. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch (150- to 229-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and grate.
7. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches (1500 mm).
8. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section. Install in accordance with the manufacturer's requirements.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings. Frames and grates to be manufactured in North America.

1. Size: 24 by 24 inches (610 by 610 mm) minimum, unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

1. Set frame on mortared brick courses true to grade and concentric with the opening. All voids beneath the bottom flange and in the brick courses shall be completely filled to make a watertight fit. A ring of mortar at least 1 inch thick shall be placed around the outside of the bottom flange, extending to the edge of the manhole all around its circumference. The bricks and mortar shall not extend beyond the top of precast concrete cone section.

3.3 ALTERING EXISTING CATCH BASINS

A. When altering existing catch basins, the structure shall be dismantled sufficiently to allow reconstruction in accordance with the applicable requirements as shown on the Drawings for complete catch basins. Each altered catch basin shall be cleaned of all accumulated silt, debris or foreign matter prior to final acceptance of work.

END OF SECTION

SECTION 33 11 00

PIPING – WATER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Sections Includes:
1. This Section includes water-distribution piping and related components outside the building for water service.
2. This Section includes water-distribution piping and related components outside the building for fire-service mains.
3. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

B. Related Sections include the following:
1. Division 02 Section “Existing Utilities and Structures” for construction effecting existing utilities and structures.
2. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
3. Division 31 Section "Lateral Support and Protection" for protection of excavations

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.

2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Owner's Representative or Local Utility no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without written authorization from Owner's Representative or Local Utility.

1.7 COORDINATION

A. Coordinate connection to water main with Portland Water District.

PART 2 - PRODUCTS – Per Portland Water District Standards.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

B. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

C. Comply with NFPA 24 for fire-service-main piping materials and installation.

D. Bury piping with minimum depth of cover over top at least 72 inches.

E. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

F. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.3 JOINT CONSTRUCTION

A. Make pipe joints according to the following:
1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
3. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.4 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.5 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.6 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.7 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

3.8 CLEANING & DISINFECTING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.

2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION

SECTION III: Water Main Materials Specifications

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NOTE:

- All installations shall follow manufacturer's recommended procedures unless otherwise noted or directed by PWD personnel.
- All materials, products and coating that contact drinking water shall be certified to meet NSF/ANSI Standard 61 – *latest revision*, Drinking Water System Components – Health Effects.

BOLTS AND NUTS

GENERAL SPECIFICATIONS

General Description of Properties Required:

1.0 Stainless Steel: Type 304 – contains the addition of Molybdenum to the nickel-chromium steels.

2.0 High Strength/Low Alloy Steel: Trade name for cold formed T-head bolts containing alloying elements such as copper, nickel, and chrome (Cor-Ten).

CAST IRON OR DUCTILE IRON SPLIT REPAIR SLEEVE

GENERAL SPECIFICATIONS

1.0 Split repair sleeve shall be mechanical joint.

2.0 The side rubber gaskets shall be rectangular to cross-section and shall fit into grooved channels in the casting. These gaskets shall extend the entire length of the sleeve.

3.0 Split repair sleeve shall be AB-CD pattern to permit use of plain rubber and duck-tipped gaskets for various O.D. piping sizes.

4.0 Mechanical joint with accessories furnished; glands, gaskets and Cor-Ten T-bolts and nuts or equal.

5.0 All side bolts shall be Stainless Steel (Type 304) or silicone bronze.

6.0 Interior and exterior to be bituminous coated with a minimum of 4 mils D.F.T.

7.0 The sleeve shall be provided with a 2" F.I.P.T. test port with brass plug.

APPROVED MANUFACTURERS

A. All Manufacturers

CORPORATION STOPS

GENERAL SPECIFICATIONS

1.0 Conforming to AWWA C-800.

2.0 ¾" to 2" curb stops shall be ball valve design with brass ball that is teflon coated or brass ball with teflon seats.

3.0 The ball shall be supported by seats which are water tight in either direction.

4.0 The valve shall have a full port opening.

5.0 The body of the corporation stop shall be of heavy duty design.

6.0 The valve working pressure shall be 300 p.s.i.

APPROVED MANUFACTURERS

A. A.Y. McDonald
B. Cambridge Brass
C. Ford Meter Box Co.
D. Mueller Co.

CURB STOPS

GENERAL SPECIFICATIONS

1.0 Conforming to AWWA C-800

2.0 ¾" to 2" curb stops shall be ball valve design with brass ball that is teflon coated or brass ball with teflon seats.

3.0 The ball shall be supported by seats which are water tight in either direction.

4.0 The valve shall have a full-port opening.

5.0 The valve shall open with ¼ turn (90°) with a check or stop.

6.0 The valve shall not have a drain.

7.0 The valve stem shall have 2 "O" rings and a bronze ring lock which holds the stem solidly in the valve body.

8.0 The valve body shall be of heavy duty design.

9.0 The valve working pressure shall be 300 p.s.i.

APPROVED MANUFACTURERS

A. A.Y. McDonald
B. Cambridge Brass
C. Ford Meter Box Co.
D. Mueller Co.

CUT-IN SLEEVE

GENERAL SPECIFICATIONS

1.0 The sleeve shall be mechanical joint to plain-end type.

2.0 The sleeve shall fit over either AB or CD pattern pipe.

3.0 Coatings:
a) Interior – Seal-coated – AWWA C104-74, min. 4 mils D.F.T.
b) Exterior – Bituminous coated, min. 4 mils D.F.T.

4.0 Mechanical joint accessories shall be furnished:
a) Glands: Duck-tipped for AB pipe, Plain Gaskets for CD pipe
b) Cor-Ten tee bolts and nuts

5.0 Cut-in sleeves shall have at least one stop-screw in sizes up through 10” and at least 2 stop-screws in 12” size.

6.0 The stop-screw “O” ring shall be recessed into the body of the sleeve between stop-screw and body.

APPROVED MANUFACTURERS

A. Mueller Co.

DUCTILE IRON FITTINGS

INCLUDING BENDS, REDUCERS, OFF-SETS, TEES AND SLEEVES

GENERAL SPECIFICATIONS

7.0 Material shall be ASTM A536 latest, grade 70-50-05, in accordance with AWWA C110 (latest revision) for fittings larger than 24" and C153 (latest revision) for fittings 3" thru 24".

8.0 Fittings shall be cement lined AWWA C104 (latest revision) or fusion bonded epoxy coated with a 5 mil nominal thickness per AWWA C550 and C116.

9.0 Interior seal coated AWWA C104 with minimum of 4 mils dry film thickness.

10.0 Exterior bituminous coated, 4 mils minimum dry film thickness or fusion bonded epoxy coated with a 5 mil nominal thickness per AWWA C550 and C116.

11.0 Sleeves shall not be cement lined, but shall be bituminous coated inside to 4 mils dry film thickness. All sleeves shall be long body type.

12.0 Mechanical joint with accessories furnished: D.I. glands, gaskets, Cor-Ten T-bolts and nuts.

13.0 Pressure Ratings:
a) Class 350 pressure rating in accordance with AWWA C153 - 3"-24" sizes.
b) Class 250 pressure rating in accordance with AWWA C110 - 30"-48" sizes.

14.0 The "compact design" fittings must provide adequate space for the MJ joint and accessories to be installed without special tools (i.e. Lowell wrench can be used).

APPROVED MANUFACTURERS

A. All Manufacturers

DUCTILE IRON PIPE

GENERAL SPECIFICATIONS

1.0 Ductile iron pipe shall meet requirements of AWWA Standard C-151 (latest revision) and be cement lined and seal coated to meet AWWA Standard C-104 (latest revision).

2.0 Joints shall meet requirements of AWWA C-111 (latest revision).

3.0 Interior seal coated, bituminous paint oil cut, emulsion not acceptable, thickness minimum of 2 mils dry film thickness.

4.0 Exterior bituminous coated with minimum of 2 mils dry film thickness.

5.0 Class 52 wall thickness, 4-inch diameter through 12-inch diameter inclusive.

6.0 Ductile Iron Pipe with diameters 16-inches and larger shall be approved by PWD.

7.0 State nominal laying length and mark shorter lengths near bell.

8.0 Mechanical joint pipe to be furnished with gland, gaskets and Cor-Ten bolts and nuts.

APPROVED MANUFACTURERS

A. American Cast Iron Pipe
B. Griffin Pipe
C. U.S. Pipe
D. Clow Pipe
E. McWain Pipe
F. Atlantic States Pipe

FIRE HYDRANT

GENERAL SPECIFICATIONS

1.0 The hydrant shall open right.

2.0 The operating nut shall:
a) be D.I. or bronze
b) be pentagon in shape with dimensions: Top 1-13/16" tapering to 1-7/8" on bottom.

3.0 Nozzles shall be:
a) 2 each – 2-1/2" National Standard Thread
b) 1 each – 4-1/2" National Standard Threadbottom.

4.0 Port covers shall be supplied without chains and shall have the same size pentagon operator as specified in 3.0(b) above.

5.0 Traffic model hydrant with breakaway feature

6.0 Barrel length(s) shall be:
a) 6 ft. cover, 6-1/2 ft. bury; or
b) 5-1/2 ft. cover, 6 ft. bury, or
c) 5 ft. cover, 5'-6" bury

7.0 Hydrant shoe or base shall have the following:
a) 6" MJ inlet;
b) 5-1/4" valve opening with non-draining bronze seat that is permanently plugged;
c) valve seat and sub-seat arrangement shall be bronze to bronze;
d) Horizontal and vertical blocking planes manufactured into hydrant base

8.0 Bolts:
a) all buried mechanical joint bolts and nuts (T-head, etc.) shall be Cor-Ten or equal;
b) all buried flange joint bolts shall be stainless steel (Type 304) or silicone bronze.

9.0 Protective Coatings shall consist of the following:
a) all paintings and coatings shall be a minimum of 3 mils total dry film thickness, unless noted
b) the internal area of the hydrant base, which is normally exposed to water and which includes the internal body of hydrant shoes, including lower valve plate, shall be epoxy coated
c) all internal and external cast iron or ductile iron components shall be coated with an approved bituminous coating, 3 mils minimum
d) Coatings for upper barrel - exterior:
    1. Surface preparation blast clean SSPC-SP-6
    2. Primer Sherwin Williams Red Oxide E61RC21, 1.5 mils, dry
    3. Finish coat Sherwin Williams – Regal Yellow, F78Y30, 1.5 mils, dry or sufficient paint to hide the second coat
    4. Total dry film thickness - 3 mils minimum.
e) Coatings for bonnet, operating nut, port cap:
    1. Surface preparation: Blast clean, SSPC-SP-6
    2. Exterior primer
    3. Exterior aluminum
    4. Total dry film thickness: 3 mils minimum.

10.0 Flow Indicator Collars: PWD personnel shall install flow indicator collars on all new hydrants.

FIELD TEST OF INSTALLED HYDRANT

1.0 Hydrant flow shall completely stop with no more than 200 ft. lb. of torque applied to the operating nut.

2.0 Failure to shut completely at no more than 200 ft. lb. of torque will be cause for rejection of that hydrant.

APPROVED HYDRANTS

A. Clow Eddy – with lower stern machined from bar stock
B. American Darling Models: B62B-1, B62B-5

PIPE JOINT RESTRAINER

GENERAL SPECIFICATIONS

1.0 Pipe Restraints:

1.1 Use in conjunction with mechanical joint fittings.

1.2 The joint restraint ring and its wedging components shall be made of ductile iron conforming to ASTM A536-80.

1.3 Dimensions of the restrainer must allow use with standard M.J. bell conforming to AWWA C111 and AWWA C153.

1.4 Restrainer must restrain up to 350 psi of working pressure in 3" to 16" sizes and 250 psi of working pressure in 18" to 48" sizes with a 2:1 safety factor.

1.5 Torque limiting twist off nuts shall be used to ensure proper actuation of the restraining wedges (used on a,b,c below).

APPROVED MANUFACTURERS

A. Sigma Super Lug
B. Ford Uni-Flange Series 1400
C. Ebba Mega Lug
D. Romac Grip Ring
E. Star Grip Series 300
F. Romac Romagrip
G. MJ FIELD LOK Gasket

POLYETHYLENE ENCASEMENT

GENERAL SPECIFICATIONS

1.0 Tube type polyethylene encasement shall be installed on all ductile iron pipe and fittings in accordance with AWWA Standard C105 - latest revision, Method A.

2.0 Polyethylene encasement shall be either linear low-density polyethylene (LLDPE) film with a minimum thickness of 8-mil or high-density, cross-laminated polyethylene (HDCLPE) film with a minimum thickness of 4-mil.

3.0 Circumferential wraps of tape or plastic tie straps shall be placed at 2-ft. intervals along the barrel of the pipe.

4.0 The polyethylene encasement shall prevent contact between the pipe and the surrounding backfill and bedding material but is not intended to be a completely airtight or watertight enclosure. All lumps of clay, mud, cinders, and so forth, on the pipe surface shall be removed prior to installation of the polyethylene encasement. During installation, care shall be exercised to prevent soil or embankment material from becoming trapped between the pipe and the polyethylene.

5.0 The polyethylene film shall be fitted to the contour of the pipe to effect a snug, but not tight, encasement with minimum space between the polyethylene and the pipe. Sufficient slack shall be provided in contouring to prevent stretching the polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, bolted joints, or fittings, and to prevent damage to the polyethylene due to backfilling operations. Overlaps and ends shall be secured with adhesive tape, string, plastic tie straps, or any other material capable of holding the polyethylene encasement in place until backfilling operations are complete.

6.0 Three layers of polyethylene adhesive tape shall be wrapped around any polywrapped pipe where a tapping machine will be placed. All copper services connected to a pipe wrapped in polyethylene encasement shall be wrapped within three feet of the pipe.

PVC WATER PIPE

GENERAL SPECIFICATIONS

1.0 For all water main installations that are less than 4" I.D. (4" and larger use ductile iron), the District will require use of 2" I.D. PVC plastic water pipe meeting the following: Under special site conditions the District does require the use of C-900 PVC in sizes larger than 4".

2.0 Pipe Specifications (2"):

2.1 Diameter:
A. The I.D. shall be a minimum of 2"
B. The O.D. shall be a maximum of 2.38"
C. The minimum wall thickness shall be 0.113"

5.2 Pressure Rating
A. The minimum working pressure rating shall be 200 PSI (SDR-21).
B. The pipe shall conform to standard ASTM 2241.

1.3 Pipe Length
A. The pipe shall be provided in 20' lengths.
* Shorter lengths may be allowed and/or field cut following manufacturer's recommended procedures.

5.2 Gaskets
A. The gasket or O-Ring material shall be rubber meeting ASTM F 477 and of the "permanent use" type.

3.0 Fittings:

3.1 Standard AWWA C900 fittings are not available in the 2" I.D. and therefore "steel pipe" class fittings, or Certa-Lok Yelomine couplings and fittings meeting ASTM D 3139 shall be used.

5.2 The normal nomenclature for "steel fittings" is Schedule 40 or Schedule 80, with the respective pressure ratings of 280 PSI and 400 PSI. Both of these fitting classes are acceptable for use.

4.0 Service Connections:

4.1 All service connections shall be made with tapping saddles* per Portland Water District specifications or by use of tees meeting the above noted fitting specifications.

5.0 Installation:

5.1 Follow manufacturer's instructions.

5.2 An eight gauge bare copper wire shall be fastened to the buried PVC pipe to facilitate electronic pipe locating. The wire shall be fastened at two locations per length and not at any joint.

6.0 The District requires 200 PSI (SDR-14) PVC pipe for other sizes such as 4", 6", 8", and 12". Pipe shall conform to AWWA C-900.

APPROVED MANUFACTURER / TYPE

A. J-M Manufacturing - Blue Brute
B. Certainteed - Yelomine
C. Victaulic - Aquamine
D. IPEX – Blue Brute

RESILIENT SEATED GATE VALVE

GENERAL SPECIFICATIONS

1.0 Valve shall meet the latest revision of the AWWA C-509 Standard.

2.0 Valve shall have a smooth unobstructed water way which shall be a minimum diameter of the valve.

3.0 Valve ends to be specified and shall be furnished with Cor-ten (or equal) bolts and nuts.

4.0 Valve shall be rated for zero leak rate at 200 psi differential working pressure and have a 400 psi hydrostatic test for structural integrity.

5.0 Sealing - Valve shall have a minimum of 2 “O” rings situated such that the “O” rings above the thrust collar can be replaced with the valve under pressure and in the open position.

6.0 Stem - Valve stem shall:
- a) open right with a stem nut made of grade D,E manganese bronze;
- b) be non-rising;
- c) be designed with a thrust collar integrally cast to the stem;
- d) be designed with two (2) thrust washers, placed one above and one below the stem thrust collar;
- e) be constructed of grade D,E manganese bronze;
- f) be such that the thrust washers are made of a synthetic polymer with physical properties required.

7.0 Valve Body - The body, including the stuffing box and the bonnet, shall be constructed of cast iron or ductile iron, meeting the latest revision of AWWA C-153.

8.0 Valve Wedge:
- a) shall be constructed of ductile iron (less guiding mechanism);
- b) shall be fully encapsulated and permanently bonded with a resilient elastomer;
- c) shall be constructed such to allow the flushing of any interior exposed surface during operations.

9.0 Coatings:
- a) the internal and external valve body, including the stuffing box, bonnet, and interior of the wedge shall be fusion bonded epoxy coated with 8 mils D.F.T.
- b) interior shall meet latest version of AWWA C-550.
- c) shall be holiday free, interior and exterior, per testing method described in AWWA C-550, Sec. 5.1.

10.0 Operating Nut:
- a) shall be two (2) inch square ductile iron:
  - 2. with a countersunk hold down nut (made of 316 stainless steel or silicone bronze). This applies to stems that are tapered; or
  - 3. with a stainless steel pin inserted thru the stem. This applies to stems of full diameter.

11.0 Bolts – The seal plate and bonnet bolts shall be stainless steel (Type 316 or Type 304).

12.0 Valves 12" nominal diameter and smaller shall be directly operated by the nut on the valve stem and mounted vertically. Number of turns to open or close shall closely match the formula: (3 x D) + 2. For example, a 12" valve should open or close with approximately (3 x 12) + 2 = 38 turns of the operating nut.

13.0 Valves larger than 12" nominal diameter shall be designed to be installed horizontally and shall have bevel gear operators driven by the operating nut. Valves 14" – 24" nominal diameter shall have 4:1 bevel gear operators. Valves with 30" – 36" nominal diameters shall have 6:1 bevel gear operators and valves with 42" – 48" nominal diameters shall have 8:1 bevel gear operators. Number of turns to open or close shall closely match the formula: ((3 x D) + 2) times the bevel gear ratio. For example, a 24" valve should open or close with approximately ((3 x 24) + 2) x 4 = 296 turns of the operating nut.

GENERAL PROVISIONS

1.0 Vendor shall identify any and all exceptions to the specifications.

2.0 Vendor shall provide standard brochures for item quoted.

3.0 Vendor may be required to supply a valve for inspection and determination of coating process.

APPROVED RESILIENT SEATED GATE VALVES

A. U.S.P.
B. AFC Series 2500
C. Mueller A-2360/61
D. Clow Series F6100

RESTRAINED JOINT GASKETS

GENERAL SPECIFICATIONS

1.0 All accepted restrained joint gaskets in the Portland Water District distribution system shall be rated in accordance with the performance requirements of ANSI/AWWA C111/A21.11.

2.0 Required Applications

2.1 Any hydrant branch or service with a distance greater than 18' shall have an approved restrained joint gasket in the bell ends.

2.2 Where a casing is required, all joints within the casing shall have an approved restrained joint gasket unless restrained joint pipe is used.

2.3 At any time as required by a PWD Engineer.

2.4 Any live service tap where there is a joint between the connection and the end of the service.

APPROVED MANUFACTURERS

A. American Fast-Grip Gasket – American Pipe
B. Field Lok 350 Gasket – US Pipe

SERVICE BOX AND ROD

GENERAL SPECIFICATIONS

Reference Standard Details

1.0 Service Box - Approved Manufacturers: Laroche, Clow Canada, Bibby

1.1 Shall be 1.0" Schedule 40 steel pipe with top having 1.0" N.P.T. pipe threads for screw-on cover or coupling.

1.2 Shall be Erie style with 6' slide-type riser.

1.3 Any extension of a service box requires a threaded merchant coupling with no set screw.

2.0 Service Box Cover – Approved Manufacturers: Bibby, Laroche, Clow Canada, QWP

2.1 Shall be Quincy type (heavy duty) cover that screws on Service Box (1.1 above).

2.2 Shall be tapped with a 1" rope thread with a solid brass plug with pentagon operating head.

3.0 Service Box Foot Piece – Approved Manufacturer: Laroche

3.1 The standard foot piece shall be heavy duty (Ford style or equal) cast iron design.

3.2 The large, heavy-duty foot piece shall have an arch that will fit over 2" ball-valve curb stops.

4.0 Service Rod – Approved Manufacturer: North American Manufacture

4.1 Shall have a self aligning design.
a) 36" length for all services.
b) 24" length for air valves.

4.2 Shall be round and constructed of stainless steel (304) with an epoxy coating (minimum 4 mil D.F.T.).

4.3 Shall have a yoke design that is an integral part of the rod.

4.4 The curb-stop attachment pin shall be a brass cotter pin.

4.5 The rod "wrench-flat" shall have a minimum thickness of ¼" tapered to 1/16" and width of 5/8" or ½".

4.6 Diameter
a) ½", ¾" and 1" services use ½" diameter.
b) 1 ½" and 2" services use 5/8" diameter.

SERVICE SADDLES

GENERAL SPECIFICATIONS FOR DUCTILE IRON PIPE

1.0 The service saddle shall have the "larger sized" body, the same as associated with the "service repair" saddle, which shall have a minimum diameter of 6 in. and multiple "O" ring type sealing.

2.0 The saddle body shall be constructed of epoxy coated ductile iron.

3.0 The sealing gasket(s) shall be either Buna-N rubber or SBR rubber (ASTM D2000).

4.0 Service saddles shall be installed with all 1 1/2" and 2" corporation stops (cc only).

Approved Manufacturers

Size	Tap	Saddle
2" – 2-1/4"	¾", 1" cc	Smith-Blair 315, Ford FC 202
4" - 12" D.I.	¾"- 11/2" cc	Smith Blair 331
4" - 12" D.I.	2" cc	Smith-Blair 313
16"	¾"-2" cc	Smith-Blair 313
20" – 36"	¾"-2"cc	Smith-Blair 366

GENERAL SPECIFICATIONS FOR PVC PIPE

1.0 Stainless steel straps will be used on saddles on C-900 PVC Pipe

Approved Manufacturers

Size	Tap	Saddle
2" – 2-1/4"	¾", 1" cc	Smith-Blair 315, Ford FC 202
4"-12"		Smith-Blair 265

GENERAL SPECIFICATIONS FOR HDPE PIPE

1.0 Spring washers are required for service saddles on HDPE Pipe.

Approved Manufacturer

Size	Tap	Saddle
4"-12"		Smith-Blair 265

STAINLESS STEEL REPAIR CLAMPS

GENERAL SPECIFICATIONS

1.0 The sleeve shall be of full circle design, either one piece or two piece, for pipe sizes 2" thru 12".

2.0 Body: Shall be 18-8 stainless steel shell.

3.0 Gasket:
- a) Shall be full length and diameter of the body size;
- b) This gasket shall form a multiple O-ring, or grid, sealing barrier for the entire length and circumference;
- c) Shall be virgin SBR rubber (ASTM D2000 AA 415).

4.0 Lugs, sidebar, and lifting bar shall be heavy gauge 18-8 stainless steel with TIG/MIG welding and chemical passivation of all welds.

5.0 Bolts and Nuts shall be Teflon coated 18-8 heavy gauge stainless steel.

6.0 Armor: The armor, or bridging plate between the side bars shall be heavy gauge 18-8 stainless steel bonded to the gasket to bridge the lug area.

APPROVED MANUFACTURERS

A. All Manufacturers

TAPPING SLEEVES

GENERAL SPECIFICATIONS

1.0 For sizes 12" and smaller tapping sleeve shall be ductile iron or approved fabricated steel:

1.1 Tapping sleeve shall be mechanical joint with recessed outlet flange for tapping valve.

1.2 Tapping sleeve shall conform to AWWA C-207, Class D, with rated maximum working pressure of 200 psi.

1.3 The side rubber gaskets shall be rectangular in cross-section and fit into grooved channels in the casting. These gaskets shall extend the entire length of the sleeve and shall not require cutting or trimming to match MJ end gaskets.

1.4 Tapping sleeve shall be AB-CD pattern to permit use of plain rubber and duck-tipped gaskets for various O.D. piping sizes.

1.5 Mechanical joint with accessories furnished; glands, gaskets, and Cor-Ten T-bolts and nuts or equal.

1.6 All flange outlet bolts shall be stainless steel (Type 304).

1.7 Interior and exterior to be bituminous coated with a minimum of 4 mils dry film thickness or fusion bonded epoxy coated.

1.8 The sleeve shall be provided with a ¾" F.I.P.T. test port and brass lug.

2.0 For sizes 16" and larger tapping sleeve shall be fabricated steel:

2.1 Body and Flange - A-36

2.2 Coating - Fusion-bonded epoxy coating with minimum D.F.T. of 5 mils, inside and out.

2.3 Bolts, Nuts - Stainless Steel (Type 304).

2.4 Gaskets - SBR.

2.5 Flange - AWWA Class D plate flange with ANSI 150# drilling, proper recessing for tapping valves.

2.6 Sleeves shall be provided with 3/4" F.I.P.T. test port and plug.

APPROVED MANUFACTURERS (4"-12")

A. AFC
B. Mueller Co.
C. U.S. Pipe
D. Tyler / Union
E. Powerseal Model 3490 and 3490MJ (Fabricated Steel)

APPROVED MANUFACTURERS (16" and larger)

A. Romac FTS 420
B. Ford FTSC
C. Smith Blair 622
D. JCM 412
E. Powerseal Model 3490 and 3490 MJ (up to 24")
F. JCM 415 or approved equal (for RCCP pipe only)

VALVE BOXES

GENERAL SPECIFICATIONS

Reference Standard Details

1.0 The valve box bottom section shall be slide-type with bell-type base with bottom lip.
Manufacturer: North American Manufacture

2.0 The valve box top section shall be slide-type, 36 inches long (minimum). No top flange and no "bead" or bottom flange.
Manufacturer: North American Manufacture

3.0 The valve box cover shall be a 2" drop-type cover to fit the 7-1/4" opening of the top section.
Manufacturer: Bibby St-Croix (no substitute)

4.0 The valve box intermediate (mid) section shall be slide-type with a minimum 3" belled bottom. Base section No. 645 may be used as an alternate.
Manufacturer: North American Manufacture

5.0 Material shall be cast iron or ductile iron free from defects.

6.0 Interior and exterior of all components shall be bituminous coated with a minimum of 4 mils dry film thickness.

SECTION 33 31 00

PIPING - SANITARY SEWER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes gravity-flow, non-pressure sanitary sewerage outside the building.

1.3 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water (30 kPa).

B. Related Sections include the following:
   1. Division 02 Section “Existing Utilities and Structures” for construction effecting existing utilities and structures.
   2. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
   3. Division 31 Section "Lateral Support and Protection" for protection of excavations
   4. Division 33 Section “Manholes”.

1.4 SUBMITTALS

A. Product Data: For pipe and fittings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings, NPS 15 (DN 375) and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

2.2 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
   1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2.3 PIPE INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:

   1. Available Manufacturers:

      a. DiversiFoam Products.
      b. Dow Chemical Company.
      c. Owens Corning.
      d. Pactiv Building Products Division.

   2. Type IV, 1.60 lb/cu. ft. (26 kg/cu. m), unless otherwise indicated.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use cast-in-place concrete supports or anchors.
3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.

D. No pipe installed will be allowed to begin at any point other than a manhole or other appurtenance without the expressed consent of the Owner's Representative. The interior of each length of pipe will be swabbed and wiped clean before installing the next length. No length of pipe shall be installed until the previous length has had sufficient fine material placed and tamped about it to secure it firmly in place to prevent any disturbance. Bell ends shall be installed uphill. Whenever the work is stopped temporarily, or for any reason whatsoever, the end of the pipe shall be carefully protected against dirt, water, or other extraneous material. Bedding shall be as shown on the drawings.

E. The pipe shall be bedded in a compacted pipe bedding material placed on a flat trench bottom to the limits indicated on the drawings.

F. The pipe shall be cut as necessary for appurtenances. Sufficient short lengths of pipe shall be furnished so that pipe entering and leaving appurtenances shall not be more than 2 feet in length measured from the inside face of the manhole or structure

G. Pipe Cutting: The cutting of the pipe shall be done in accordance with the pipe manufacturer's recommendations. The pipe material shall be cut by using a saw or milling process, approved by the pipe manufacturer and not by using any impact device, such as a hammer and chisel, to break the pipe. The pipe shall be cut, not broken. The cut end of the pipe shall be square to the axis of the pipe and any rough edges ground smooth.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:
1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
2. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 PIPE INSULATION

A. Install 2-in. thick x 4-ft. wide insulation over pipe when noted on plans or as directed by the Owner's Representative.

3.5 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use detectable warning tape over nonferrous piping.

3.6 FIELD QUALITY CONTROL AND TESTING

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspection to be performed with Owner's Representative present. Inspect after approximately 24 inches (610 mm) of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.

C. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

1. Equipment Requirements:

    a. Pneumatic Plugs: Sealing length equal to or greater than the diameter of the pipe to be tested.
    b. Pneumatic Plugs: Size and type to resist internal test pressures without requiring external bracing or blocking.
    c. All air used shall pass through a single control panel.
    d. Use three individual hoses for the following connections:

1) From control panel to pneumatic plugs for inflation.
2) From control panel to sealed line for introducing the low pressure air.
3) From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

2. Procedures:

a. Pneumatic Plug Seal Testing:

1) Before being used in the actual test installation, lay one length of pipe on the ground and seal at both ends with the pneumatic plugs to be checked.
2) Introduce air into the plugs to 25 psig.
3) Sealed pipe shall be pressurized to 5 psig.
4) The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.

b. Pipe:

1) Place plugs in the line and inflate to 25 psig.
2) Introduce low pressure air into sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of groundwater over the pipe.
3) Wait at least two minutes for the air pressure to stabilize.
4) After the stabilization (3.5 psig minimum pressure in the pipe), disconnect the air hose from the control panel to the air supply. The portion of line being tested shall be termed "acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any groundwater that may be over the pipe) is greater than 4 minutes.

c. Where Groundwater is Known to Exist:

1) Install a one-half inch diameter capped pipe nipple, approximately 10′ long, through the manhole wall on top of one of the pipes entering the manhole, at the time the pipe is installed.
2) Immediately prior to the performance of the Line Acceptance Test, determine the groundwater by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connect a clear plastic tube to the nipple.
3) The hose shall be held vertically and a measurement of the height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. (For example, if the height of water is 11-1/2 feet, then the added pressure will be 5 psig, add the 2.5 psig to 7.5 psig. The allowable drop of one pound and the timing remain the same).

d. Should the pipe, as laid, fail to meet these requirements, perform the necessary work to meet these requirements, without additional cost to the Owner.

D. Leaks and loss in test pressure constitute defects that must be repaired.

E. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.7 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION

SECTION 33 41 00

PIPING - STORM DRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes gravity-flow, nonpressure storm drainage outside the building.

B. Related Sections include the following:
1. Division 02 Section “Existing Utilities and Structures” for construction effecting existing utilities and structures.
2. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
3. Division 31 Section “Rock Excavation” for rock removal.
4. Division 31 Section "Dewatering" for dewatering of excavations.
5. Division 31 Section "Excavation Support and Protection" for protection of excavations
6. Division 33 Section “Catch Basins”.

1.3 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: Pipe joints shall be at least silttight, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For pipe and fittings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

PART 2 - PRODUCTS

2.1 HDPE PIPE AND FITTINGS

A. Corrugated HDPE Drainage Pipe and Fittings NPS 10 (DN 250) and Smaller: AASHTO M 252M, Type S, with smooth waterway for coupling joints.

1. Silttight Couplings: HDPE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

B. Corrugated HDPE Pipe and Fittings NPS 12 to NPS 48 (DN 250 to DN 1200): AASHTO M 294M, Type S, with smooth waterway for coupling joints.

1. Silttight Couplings: HDPE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

C. Corrugated HDPE Pipe and Fittings NPS 56 and NPS 60 (DN 1400 and DN 1524): AASHTO MP7, Type S, with smooth waterway for coupling joints.

1. Silttight Couplings: HDPE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

2.2 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2.3 PIPE INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:

1. Available Manufacturers:

a. DiversiFoam Products.
b. Dow Chemical Company.
c. Owens Corning.
d. Pactiv Building Products Division.

2. Type IV, 1.60 lb/cu. ft. (26 kg/cu. m), unless otherwise indicated.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use cast-in-place concrete supports or anchors.
3. Install piping below frost line, unless noted otherwise.
4. Install PE pipe according to ASTM D 2774 and ASTM F 645.

D. No pipe installed will be allowed to begin at any point other than a manhole or other appurtenance without the expressed consent of the Owner's Representative. The interior of each length of pipe will be swabbed and wiped clean before installing the next length. No length of pipe shall be installed until the previous length has had sufficient fine material placed and tamped about it to secure it firmly in place to prevent any disturbance. Bell ends shall be installed uphill. Whenever the work is stopped temporarily, or for any reason whatsoever, the end of the pipe shall be carefully protected against dirt, water, or other extraneous material. Bedding shall be as shown on the drawings.

E. The pipe shall be bedded in a compacted granular or stone pipe bedding placed on a flat trench bottom. The bedding material shall be as indicated on the drawings and compacted to at least 90%. The remainder of the cover to a minimum of 6 inches over the top of the pipe shall be filled as indicated on the drawings and compacted to at least 90%.

F. The pipe shall be cut as necessary for appurtenances. Sufficient short lengths of pipe shall be furnished so that pipe entering and leaving appurtenances shall not be more than 2 feet in length measured from the inside face of the manhole.

G. Pipe Cutting: The cutting of the pipe shall be done in accordance with the pipe manufacturer's recommendations. The pipe material shall be cut by using a saw or milling process, approved by the pipe manufacturer and not by using any impact device, such as a hammer and chisel, to

break the pipe. The pipe shall be cut, not broken. The cut end of the pipe shall be square to the axis of the pipe and any rough edges ground smooth.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:
   1. Join corrugated HDPE piping according to CPPA 100 and the following:
      a. Use silttight couplings for Type 2, silttight joints.
   2. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
   3. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 PIPE INSULATION

A. Install 2-in. thick x 4-ft. wide insulation between pipe and culvert or over pipe when noted on plans or as directed by the Owner's Representative.

B. Install 6 in. above the pipe unless otherwise shown on Drawings.

3.5 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 mm) of backfill is in place, and again at completion of Project.

   1. Submit separate reports for each system inspection.
   2. Defects requiring correction include the following:

      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
      c. Crushed, broken, cracked, or otherwise damaged piping.
      d. Infiltration: Water leakage into piping.
      e. Exfiltration: Water leakage from or around piping.

   3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
   4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

   1. Do not enclose, cover, or put into service before inspection and approval.
   2. Test completed piping systems according to authorities having jurisdiction.
   3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
   4. Submit separate report for each test.

3.6 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION

SECTION 33 46 00

SUBDRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes subdrainage systems for the following:

1. Foundations.

B. Related specifications are included in the following:
1. Division 31 Section "Dewatering" for lowering and disposing of ground water during construction.
2. Division 31 Section "Earth Moving" for excavation and backfilling.
3. Drawing C-300 "Erosion and Sedimentation Control" for temporary erosion and sedimentation control measures

1.3 DEFINITIONS

A. HDPE: Polyethylene plastic.

B. PVC: Polyvinyl chloride plastic.

C. Subdrainage: Drainage system that collects and removes subsurface water.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Perforated-wall pipe and fittings.
2. Solid-wall pipe and fittings.
3. Geotextile filter fabrics.
4. Clean outs

PART 2 - PRODUCTS

2.1 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated PVC Sewer Pipe and Fittings: ASTM D 2729, bell-and-spigot ends, for loose joints.

2.2 SOLID-WALL PIPES AND FITTINGS

A. PVC Sewer Pipe and Fittings: ASTM D 3034, SDR 35, bell-and-spigot ends, for gasketed joints.

1. Gaskets: ASTM F 477, elastomeric seal.

2.3 CLEANOUTS

A. PVC Cleanouts: ASTM D 3034, PVC cleanout threaded plug and threaded pipe hub.

2.4 DRAINAGE MATERIAL

A. Drainage material shall encapsulate the drain pipe will clean 3/4 inch crushed stone AS SPECIFIED IN Section 31-20-00 unless indicated otherwise.

2.5 GEOTEXTILE FILTER FABRICS

A. Mirafi 140N or equivalent.

1. Structure Type: Nonwoven, needle-punched continuous filament.
2. Style: Flat.
3. Available Manufacturer: Mirafi, 140N

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

A. Underground Subdrainage Piping:
1. Perforated PVC sewer pipe and fittings for bell-and-spigot joints.

3.3 CLEANOUT APPLICATIONS

A. In Underground Subdrainage Piping:

1. At Grade in Earth: PVC cleanouts.
2. At Grade in Paved Areas: Cast-iron cleanouts.

3.4 SUBDRAINAGE INSTALLATION

A. Place foundation backfill material as required to establish bottom of subdrainage trench at an elevation 6 inches below the expected pipe invert.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place underdrain material on geotextile filter fabric.

D. Install drainage piping as indicated.

E. Add drainage material on each side and over top of pipe to limits indicated and wrap top of drainage course with flat-style geotextile filter fabric with minimum of 6 inch overlap.

F. Place structural backfill material over compacted drainage material. Place material in loose-depth layers not exceeding 8 inches (150 mm). Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

G. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in underdrain material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.

1. Foundation Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches (915 mm), unless otherwise indicated. Pipe invert shall be located a minimum of 12 inches below the adjacent top of floor slab elevation.
2. Retaining-Wall Subdrainage: When water discharges at end of wall into stormwater piping system, install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches (915 mm), unless otherwise indicated. However, when water discharges through wall weep holes, pipe may be installed with a minimum slope of zero percent.
3. Lay perforated pipe with perforations down.
4. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.

H. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

I. Install HDPE piping according to ASTM D 2321.

3.5 PIPE JOINT CONSTRUCTION

A. Join PVC pipe and fittings according to ASTM D 3034 with elastomeric seal gaskets according to ASTM D 2321.

B. Join perforated PVC pipe and fittings according to ASTM D 2729, with loose bell-and-spigot joints.

3.6 CLEANOUT INSTALLATION

A. Cleanouts for Subdrainage:

1. Install cleanouts from piping to grade as indicated.
2. In vehicular-traffic areas, use NPS 4 (DN 100) cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 12 inches (450 by 450 by 300 mm) in depth. Set top of cleanout flush with grade. Cast-iron pipe may also be used for cleanouts in nonvehicular-traffic areas.

3. In nonvehicular-traffic areas, use NPS 4 (DN 100) PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set top of cleanout plug 1 inch (25 mm) above grade.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Underdrain Outlets: Construct of the same size and type of pipe used in the underdrain itself, except that the perforations shall be omitted.

3.8 FIELD QUALITY CONTROL

A. Testing: After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.9 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION

University of New England
Patient Care Center Equipment List

August 22, 2012

Note: The information included needs to be verified by cutsheets

PORT ▪ CITY ARCHITECTURE

Tab Num		Electrical Needs	Water Needs	Air Needs	Vacuum Needs	Provided by	Installed by	Other
1	Dental Simulation -Adec	Yes	No	Medical	Yes	Owner	Vender	Integral w/ #2
2	Simulation Casework -Nevin	Yes	No	Medical	Yes	Contract	Contract	Data - Integral w/ #1 - no gas
3	Stage Front -Simulation Clinic					Owner	Owner	Software package
4	Portable Dental X-ray -Nomad	Plug	No	No	No	Owner	Owner	Provide outlet in millwork
5A	Adec 511 Dental Chair	(2) Duplex on Floor	No	Medical	No	Owner	Vender	Provide conduit from counter to chair
5A1	Adec 511 Dental Chair	(2) Duplex on Floor	No	Medical	Yes	Owner	Vender	Provide conduit from counter to chair
5B	Adec 511 Dental Chair	(2) Duplex on Floor	No	Medical	Yes	Owner	Vender	Provide conduit from counter to chair
6	Rear Dental Cabinet -Adec 5580.42	Yes	No	Medical	Yes	Owner	Vender	
7	Lead Apron Mount	No	No	No	No	Contract	Contract	
8	X-ray Intraoral -Planmeca -Prox (new Model)	Yes	No	No	No	Owner	Vender	Need Mounting Info
9	X-ray Sensors -Schick	No	No	No	No	Owner	Owner	Need More Info & locations - tethered to computer
10	Panograph X-ray -Planmeca Promax	Yes	No	No	No	Owner	Vender	Needs a dedicated & a non-dedicated circuits
11	Pan/Ceph/3D Sirona Gallileos Comfort	220-230 v	No	No	No	Owner	Vender	Needs a dedicated & a non-dedicated circuits
12	Dental Chair -Boyd	Yes	No	No	No	Owner	Vender	Needs flush floor outlet positioned tight to base on left of chair
13	Dental Chair -Midmark	Yes	No	No	No	Owner	Vender	Needs flush floor outlet positioned tight to base on left of chair
14	Dual Instrument Delivery Cart Adec Cascade 2671	Yes	No	Yes	Yes	Owner	Vender	Connects to Wall- Needs to be drawn on plans for space allocation and Med Gas design.
15	Medical Gas Flowmeter - **NOT USED**	No	No	Yes	Yes	Owner	Vender	Tank Room Equipment by Contractor
16	Mobile Dental Microscope/Video Camera	Outlet	No	No	No	Owner	Owner	Needs secure storage
17	Wheelchair Platform Lift	Outlet	No	No	No	Owner	Owner	Will use outlet provided for dental chair
18	Ultrasonic Cleaner -Large	110 v	Yes - 1" H&C	No	No	Owner	Vender	Self contained - Provide ceramic floor sink
19	Dental Handpiece Maintenance System	Outlet	No	Yes	No	Owner	Owner	Place Holder
20A	Washers Disinfectors -Getinge 8668 (larger)	380-415 v	Yes - 1" H&C	No	No	Owner	Vender	1" RO rinse - Exhaust - Provide ceramic floor sink
20B	Washers Disinfectors -Getinge 46-4 (smaller)	380-415 v	Yes - 1" H&C	No	No	Owner	Vender	1" RO rinse - Exhaust - Provide ceramic floor sink
21	Pass Through Window Assembly	No	No	No	No	Owner	Contract	Shelf both side
22	R.O. Water Purification	120 v	Yes -	No	No	Owner	Vender	Electrical on switch - provide PVC 40 or 80 piping back to
23A	Sterilizers -Getinge 633HC (larger)	120 v con - 208-440 sterilizer	Yes - 1" C	No	No	Owner	Vender	RO connection by Vender - Exhaust may need to be directly vented to exterior - Provide ceramic floor sink

23B	Sterilizers -Getinge 500HC (smaller)	120 v con - 208-440 sterilizer	Yes - 1" C	No	No	Owner	Vender	RO connection by Vender - Exhaust may need to be directly vented to exterior - Provide ceramic floor sink
24	Countertop Sterilizer	Outlet - 220 v	No	No	No	Owner	Owner	
25	Cassette Autoclave	Outlet	No	No	No	Owner	Owner	Need grommet on counter for tubing to waste H2O bottle below on shelf. Need shelf below.
26	Refrigerator/Freezer w.o. icemaker	Outlet	No	No	No	Owner	Owner	Provide wire mold in this area
27	Lathe with Dust Collector -Countertop	Outlet	No	No	No	Owner	Owner	Provide wire mold in this area
28	Model Trimmer -Diamond Wheel	Outlet	Yes	No	No	Owner	Owner	Provide wire mold in this area - Plumbed to 34A & connect to 34B - Provide grommet
29	Vibrator -3 speed -Countertop	Outlet	No	No	No	Owner	Owner	Provide wire mold in this area
30	Vacuum Former - Countertop	Outlet	No	No	No	Owner	Owner	Provide wire mold in this area
31	Vacuum Mixer - Countertop	Outlet	No	No	No	Owner	Owner	Provide wire mold in this area
32	Visible Light Curing System	Outlet	No	No	No	Owner	Owner	Provide wire mold in this area
33	Sandblaster - Countertop	Outlet	No	No	Yes - not med	Owner	Owner	Provide wire mold in this area
34A	Disposable Plaster Trap	No	No	No	No	Contract	Contract	Plumbed to 34B
34B	Sink with drainage board both sides	No	Y	No	No	Contract	Contract	Plumbed to 34B & 28
35	Lead Shielding for Rear Consoles	No	No	No	No	Owner	Vender	Location to be confirmed
36	Radiology Chair	Outlet	No	No	No	Owner	Vender	
37	Track Mounted Ceiling Lights -Enclosed Ops	Yes	No	No	No	Owner	Vender	Provide structural support -Confirm
38	Bench Mounted Dental Light - Simulation Clinic	Outlet	No	No	No	Owner	Owner	
39	Small Refrigerator - Simulation Dispensary - No ice	Outlet	No	No	No	Owner	Owner	
40	Countertop Ultrasonic	Outlet	No	No	No	Owner	Owner	
41	CAD/CAM Technology (A= Aquistion Unit, B= Milling Unit, C=MCXL Station Cabinet)-Cerec	Outlets (A+B need out)	No	No	No	Owner	Owner	Provide counter on one side - 2 pieces of equipment. Need data connection
42	High Density Shelving -Dispensary	Yes	No	No	No	Contract	Contract	Provide SS under wheels - provide outlets on the end walls
43	Water Saver Package -Getinge -Larger Sterilizer	120 v	Yes?	No	No	Owner	Vender	Plumbing from RO to Sterilizer by the vender
44	Stainless Steel Double Sink & Counter -Soiled Room	No	Yes	No	No	Contract	Contract	Open below with shelf for detergent w/ dema tip
45	Transfer Carts -Soiled Receiving, Clean Dispensary	No	No	No	No	Owner	Owner	
46	Student Lockers - Simulation	No	No	No	No	Contract	Contract	
47	Doctor Stool - Adec	No	No	No	No	Owner	Owner	
48	Assistant Stool - Adec	No	No	No	No	Owner	Owner	
50	Lockers - Corridors	No	No	No	No	Contract	Contract	
51	Task Light - Counter Mount	Outlet	No	No	No	Owner	Owner	
52	Water Dispenser	Yes	Yes	No	No	Owner	Contract	
53	Coffee Maker	Yes	Yes	No	No	Owner	Contract	
54	Microwave	Outlet	No	No	No	Owner	Owner	
55A	Eyewash Station	No	Yes	No	No	Contract	Contract	
55B	Eyewash Station	No	Yes	No	No	Contract	Contract	
56	Stainless Steel Cassette Wrapping Table / Station	No	No	No	No	Owner	Owner	
57	Bar Code Scanner	No	No	No	No	Owner	Owner	
58	Glove Box Holder	No	No	No	No	Owner	Contract	
58	Paper Towel Dispenser	No	No	No	No	Owner	Contract	

60	Soap Dispenser	No	No	No	No	Owner	Contract	
61	Instrument Tray - On wheels - Adec Tray Mate	No	No	No	No	Owner	Owner	
62	Under Counter Trash Bins - Operatories	No	No	No	No	Owner	Owner	
63	Large Trash Containers	No	No	No	No	Owner	Owner	
64	Projection Screen	Yes	No	No	No	Contract	Contract	Controlled by Stage Front
65	Projector	Outlet	No	No	No	Owner	Owner	Provide Data
66	Flat Panel Monitor	Outlet	No	No	No	Owner	Owner	Provide Data
67	Large Monitors	Outlet	No	No	No	Owner	Owner	Provide Data
68	Computers	Outlet	No	No	No	Owner	Owner	Currently not placed on plans
69	Keyboard Trays	No	No	No	No	Owner	Owner	Currently not placed on plans
70	Printers	Outlet	No	No	No	Owner	Owner	Provide Data
71	Safe	No	No	No	No	Owner	Owner	
72	Copy/Scanner Small	Outlet	No	No	No	Owner	Owner	Provide Data
73	Copy/Scanner Large	Outlet	No	No	No	Owner	Owner	Provide Data
74	Crash Cart	Outlet	No	No	No	Owner	Owner	
75	Phones							
76	Geteringe Detergent	Outlet	No	No	No	Vender	Vender	
77	Fire Place					Contract	Contract	
78	Adec Floor Box					Vender	Contract	Recess in Wall
79	Medical Gas Control Valve - **NOT USED**							
80	Alarm Panel							

SUMMIT
GEOENGINEERING SERVICES

Geotechnical Report

UNE Dental School Building
Stevens Avenue
Portland, Maine

Prepared for:

University of New England

Prepared by:

Summit Geoengineering Services
Project #11296
January 2012

640 Main Street, Lewiston, Maine 04240, (207) 576-3313
434 Cony Road, Augusta, Maine 04330, (207) 318-7761

January 31, 2012
Summit #11296

Al Thibeau
University of New England
11 Hills Beach Road
Biddeford, Maine 04005

Reference: Geotechnical Investigation, Proposed Dental School Building
Stevens Avenue, Portland, Maine

Dear Al;

We have completed the geotechnical investigation for the proposed new dental school building at the Portland Campus. Our scope of services included performing 5 test borings at the site and preparing this report summarizing our findings and geotechnical recommendations.

1.0 Project Description

The project consists of the construction of a new building on the UNE campus at 750 Stevens Avenue in Portland. The building has a footprint of approximately 18,000 square feet. We understand that a parking level will be constructed beneath the building. The parking level will be at a depth of approximately 4 feet below the existing grade (elevation 23 feet +/-) and will have a paved surface. The location of the proposed building is currently occupied by three wood frame structures, two garages, parking lots, and lawns.

Column loads are estimated to range from 215 kips to 610 kips with a live load to dead load ratio of approximately 50% to 60%. Columns will be spaced from 15 to 35 feet.

2.0 Subsurface Exploration and Laboratory Testing

Summit Geoengineering Services (SGS) observed the subsurface conditions with the drilling of 5 borings on January 12, 2012. The borings were located by taping from existing buildings. Northern Test Borings, under contract to SGS, advanced the borings using 2¼-inch hollow stem augers. Two borings were performed to a depth of 22 feet and three borings were advanced to refusal, ranging from16.1 to 27.4 feet. Standard penetration tests (SPT) with split spoon samples were obtained at 5-foot intervals. A 1-inch diameter PCV groundwater observation well was installed in boring B-3.

Summit was onsite to coordinate and observe the boring explorations. The location of the borings is shown on Boring Location Plan in Appendix A. Logs of the explorations are included in Appendix B.

The sample taken at a depth of 5 to 7 feet in B-4 was tested for grain size analysis in accordance with ASTM 422. The results of this test are presented in Appendix A.

3.0 Subsurface Conditions

The subsurface conditions generally consist of ***topsoil*** overlying ***glacial marine deposits*** overlying ***glacial till*** explored to a depth of 16.8 to 27.4 feet. Bedrock was encountered at borings B-1, B-2, and B-4 at depths of 27.4 feet, 20.4 feet, and 16.8 feet, respectively. The subgrade is further described into 3 layers as follows:

The topsoil ranged from 6 to 12 inches in thickness consisting of dark brown silt with little sand and rootlets and is visually classified as ML in accordance with the Unified Soil Classification System (USCS). The topsoil was generally loose to compact and damp to frozen.

The glacial marine deposit consisted of light brown to tan medium-fine sand with a trace to little silt and is visually classified as SM or SP in accordance with the Unified Soil Classification System (USCS). The sample taken in B-4 at a depth of 5 to 7 feet contained 97.9% sand and 2.1% silt. This sample has a USCS classification of SP. SPT-N values for the sand ranged from 4 to 38 blows per foot (bpf) and averaged 20 bpf, indicating compact to dense conditions. The glacial marine deposits were generally damp.

The glacial till, encountered in B-1, B-2, and B-4, ranged from brown medium-fine to medium-coarse sand with little silt and gravel to brown silty clay with some sand and little gravel. The glacial till is visually classified as SM and CL in accordance with the Unified Soil Classification System (USCS). SPT-N values for the sand ranged from 54 to 62 blows per foot (bpf), indicating very dense / hard conditions. The glacial marine deposits were generally damp

Bedrock was encountered at borings B-1, B-2, and B-4 at depths of 27.4 feet, 20.4 feet, and 16.8 feet, respectively. Refusal was not encountered in the other explorations. Bedrock mapping by the Maine Geological Survey indicates the bedrock is part of the Berwick Formation consisting of fine-grained gray quartz-plagioclase biotite gneiss.

Groundwater was not observed in our explorations. Groundwater was measured at a depth of 20.3 feet in the observation well at B-3 on January 25, 2012.

4.0 Foundation Design Recommendations

Based on the proposed finished exterior grade (paved parking lot) and the required frost protection depth, the footings for the new building will be constructed on the native sandy glacial marine deposit. With proper preparation, this soil is suitable to support the proposed building on conventional spread footing foundations.

A. Allowable Bearing Pressure

We recommend that the foundations be designed using an allowable bearing pressure of 4,000 psf for interior and exterior isolated and continuous footings. For the proposed footing loads, the

total settlement associated with the above bearing pressure ranges from ½" to ¾". Due to the uniformity of the subsurface conditions, differential settlement will be negligible, on the order of 0.1%.

We recommend that the subgrade soil in the building footprint be prepared as follows:

- Remove topsoil, pavement, and existing building foundations in their entirety from within the building footprint. Voids left after the removal of existing foundations can be backfilled with the existing sandy glacial marine soil. This soil should be compacted to 95% of its maximum dry density where it is placed within the building footprint. Outside the building footprint the compaction requirement can be reduced to 90%.

- After removal and backfilling of removed foundations, the soil within the building footprint is proofrolled prior to excavating for the footings. Proofrolling should consist of making a minimum of 5 passes in 2 perpendicular directions using a large vibratory roller with a minimum operating weight of 10 tons.

- Exterior footings are constructed to a depth of 4 feet below exterior grade for frost protection.

- Footing trenches are excavated using a smoothed edge bucket to minimize disturbance to the native soil. The footing subgrade should be proofrolled to re-densify the disturbed soil. Proofrolling should consist of making a minimum of 5 passes using a large walk behind vibratory roller. Wet and soft areas, if encountered, should be removed and replaced with crushed stone.

We recommend the following parameters be used for the existing sandy glacial marine soil in the design of subsurface structures.

DESIGN PARAMETERS – EXISTING SANDY GLACIAL MARINE SOIL	
Total Natural (moist) Unit Weight (γ_t)	125 pcf
Saturated (buoyant) Unit Weight (γ_s)	63 pcf
Friction Coefficient (f)	0.45
Passive Earth Pressure Coefficient (K_p)	3.1
Active Earth Pressure Coefficient (K_a)	0.33
Friction Angle (f_c)	30^0
Cohesion (c)	0

B. Frost Protection

The design air freezing index for the Portland area is approximately 1,200 degree F days (10 year, 90% probability). Based on this, exterior footings on the existing granular fill soil should be constructed at a minimum depth of 4 feet below the exterior finished grade.

We recommend that the exterior of the foundation walls be backfilled with soil meeting the following gradation specification:

FOUNDATION BACKFILL (FB)	
Sieve Size	**Percent finer**
3 inch	100
¼ inch	60 to 100
No. 40	0 to 50
No. 200	0 to 7

Reference: MaineDOT Specification 703.06, Type F

The maximum particle size should be limited to 6 inches. The Foundation Backfill should be compacted to a minimum of 95 percent of its maximum dry density, determined in accordance with ASTM D1557. This compaction requirement can be reduced to 90% in landscaped areas.

The interior of foundation walls should be backfilled with Structural Fill as described below.

C. Building Slab

We recommend the building slab be constructed on a minimum 12-inch thick layer of Structural Fill (SF). The maximum particle size should be limited to 6 inches and meet the following gradation specifications passing the 3-inch sieve:

STRUCTURAL FILL (SF)	
Sieve Size	**Percent finer**
3 inch	100
1/4 inch	0 to 70
No. 200	0 to 10

Reference: MDOT Specification 703.20, Gravel Borrow

SF should be placed in 6 to 12-inch lifts and should be compacted to 95 percent of its maximum dry density determined in accordance with ASTM D1557.

An alternative is to construct the slab on 6 inches of ¾ inch crushed stone. The crushed stone can be placed directly on the proofrolled subgrade. It should be compacted using a vibratory roller sufficiently to lock the aggregate particles together.

For the conditions described above, the slab can be designed using a subgrade modulus of 175 pci.

We recommend the subgrade be proof-rolled as described in Section 4A of this report.

D. Groundwater Control

Groundwater was not observed in the explorations performed at the site. The water level was measured at a depth of 20.3 feet in the observation well at boring B-3 on January 25, 2012. This measurement was taken with an electronic depth meter. Based on this we anticipate that groundwater will be well below the bottom of the building footings and perimeter underdrains are not strictly necessary.

It is generally good practice to install underdrains to account for unanticipated changes in regional hydrogeology and to control potential infiltration of surface or roof runoff water into the foundation backfill. We recommend exterior grades slope away from the building footprint to reduce runoff water from infiltrating the Foundation Backfill.

Perimeter underdrains, if used, should consist of 4 inch rigid perforated PVC placed adjacent to the exterior footings and surrounded by a minimum of 6 inches of crushed stone wrapped in filter fabric to prevent clogging from the migration of the fine soil particles in the foundation backfill soils. The underdrain pipe should be outlet to a location where it will be free flowing. Where exposed at the ground surface, the ends of pipes should be screened or otherwise protected from entry and nesting of wildlife, which could cause clogging.

E. Seismic Design

Based on the depth to bedrock, the soil descriptions, and the blow counts obtained in the test borings, the soil at the site is classified as Seismic Site Class C in accordance with the International Building Code (IBC). We recommend the following seismic design coefficients be used:

SUBGRADE SITE SEISMIC DESIGN COEFFICIENTS - IBC	
Seismic Coefficient	**Site Class C**
Short period spectral response (S_S)	0.314
1 second spectral response (S_1)	0.077
Site coefficient (F_a)	1.2
Site Coefficient (F_v)	1.7
Design short period spectral response (S_{DS})	0.251
Design 1 second spectral response (S_{DS})	0.087

The sandy glacial marine are not susceptible to liquefaction based on their density.

5.0 Earthwork Considerations

Voids remaining after the removal of existing building foundations can be backfilled with the existing sandy glacial marine soil. This soil should be compacted to 95% of its maximum dry density where it is placed within the building footprint. Outside the building footprint the compaction requirement can be reduced to 90%.

Groundwater will not be an issue during construction of the footings. We recommend that surface water be diverted away from open excavations and that the footing trenches be kept dry.

We recommend that the building footprint be proofrolled as described in section 4.0A prior to placing SF or constructing foundations.

The existing glacial marine deposit may is too fine to meet the specifications for Foundation Backfill or Structural Fill.

Utility trenching and general excavations below 4 feet should be sloped no greater than 1.5H to 1V (OSHA type C) in the native sand. These slopes are based on the current OSHA Excavation Guidelines.

We recommend that a qualified geotechnical consultant be retained to monitor and test soil materials used during construction and confirm that soil conditions and construction methods are in consistence with this report.

7.0 Closure

Our recommendations are based on professional judgment and generally accepted principles of geotechnical engineering. Some changes in subsurface conditions, building elevations, and loads from those presented in this report may occur. Should these conditions differ materially from those described in this report, Summit should be notified so that we can re-evaluate our recommendations.

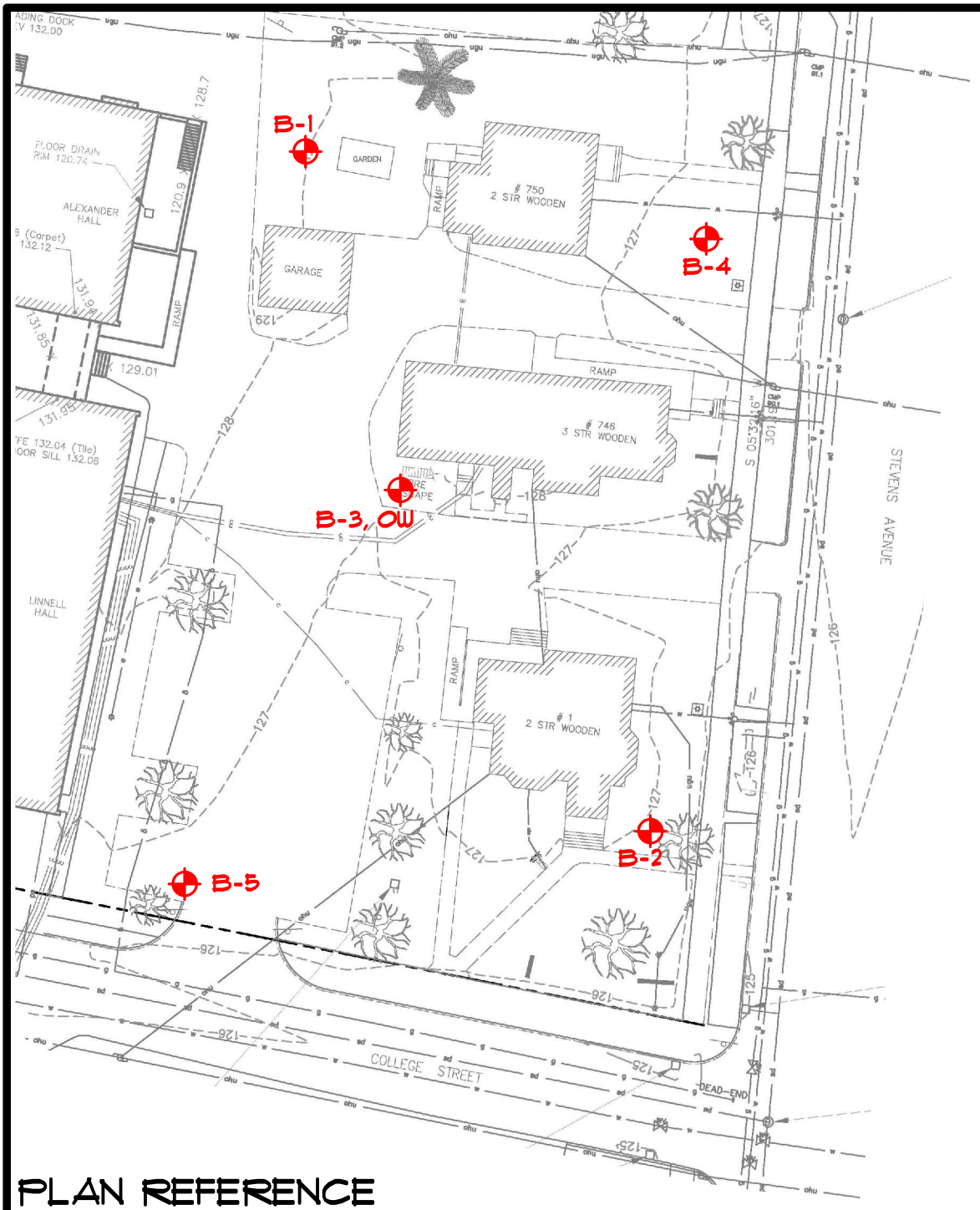
We appreciate the opportunity to serve you during this phase of your project. If there are any questions or additional information is required, please do not hesitate to call.

Sincerely yours,
Summit Geoengineering Services,

William M. Peterlein, P.E.
President & Principal Engineer

APPENDIX A

EXPLORATION LOCATION PLAN



PLAN REFERENCE

"COLLEGE OF DENTAL MEDICINE, EXISTING CONDITIONS PLAN", DATED JANUARY 2012, PREPARED BY SITE DESIGN ASSOCIATES.

LEGEND

B-1 — SUMMIT TEST BORING (1-12-2012)

TEST BORING LOCATION PLAN
COLLEGE OF DENTAL MEDICINE

STEVENS AVENUE - PORTLAND, MAINE

PREPARED FOR

UNIVERSITY OF NEW ENGLAND

DATE: JAN. 2012	DRAWN BY: KRF	CHECKED BY: WMP
JOB: 11296	SCALE: 1" = 40'	FILE: 11296 SKT

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SUMMIT
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APPENDIX B

EXPLORATION LOGS

EXPLORATION REPORT COVER SHEET

The exploration report has been prepared by the geotechnical engineer from both field and laboratory data. Differences between field logs and exploration reports may exist.

It is common practice in the soil and foundation engineering profession that field logs and laboratory data sheets not be included in engineering reports, because they do no represent the engineer's final opinion as to appropriate descriptions for conditions encountered in the exploration and testing work. The field logs will be retained in our office for review. Results of laboratory tests are generally shown on the borings logs or are described in the text of the report as appropriate.

Drilling and Sampling Symbols:

SS = Split Spoon
ST = Shelby Tube – 2" OD, disturbed
UT = Shelby Tube – 3" OD, undisturbed
HSA = Hollow Stem Auger
CS = Casing – size as noted
Sv = Vane Shear
PP = Pocket Penetrometer
RX = Rock Core – size as noted
Hyd = Hydraulic advance of probes
WOH = Weight of Hammer
WOR = Weight of Rod
GS = Grain Size Data
PI = Plasticity Index
LL = Liquid Limit
w = Natural Water Content
USCS = unified Soil Classification System

Water Level Measurements:

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable groundwater levels. In impervious soils, the accurate determination of groundwater elevations may not be possible, even after several days of observations; additional evidence of groundwater elevations via observation or monitoring wells must be sought.

Gradation Description and Terminology:

Boulders:	Over 8 inches	Trace:	Less than 5%
Cobbles:	8 inches to 3 inches	Little:	5% to 15%
Gravel:	3 inches to No.4 sieve	Some:	15% to 25%
Sand:	No.4 to No. 200 sieve	Silty, Sandy, etc.:	Greater than 25%
Silt:	No. 200 sieve to 0.005 mm		
Clay:	less than 0.005 mm		

Density of Granular Soils and Consistency of Cohesive Soils:

CONSISTENCY OF COHESIVE SOILS		DENSITY OF GRANULAR SOILS	
SPT N-value blows/ft	**Consistency**	**SPT N-value blows/ft**	**Relative Density**
0 to 2	Very Soft	0 to 3	Very Loose
3 to 4	Soft	4 to 9	Loose
5 to 8	Firm	10 to 29	Compact
9 to 16	Stiff	30 to 49	Dense
17 to 32	Very Stiff	50 to 80	Very Dense
>32	Hard		

SUMMIT
GEOENGINEERING SERVICES

SOIL BORING LOG

Boring #: **B-1**

Project: UNE Dental Building
Location: Stevens Avenue, Portland, Maine

Project #: 11296
Sheet: 1 of 2
Chkd by:

Drilling Co: Northern Test Boring
Personnel: Nick
Summit Staff: Erika Hawksley

Boring Location: Taped from existing buildings by Summit
Elevation: 128 ft +/-
Date started: 1/12/2012 Date Completed: 1/12/2012

DRILLING METHOD		SAMPLER	
Vehicle:	ATV	Type:	24" SS
Model:	Diedrich D-50	Hammer:	140 lb
Method:	2 1/4" HSA	Fall:	30"

ESTIMATED GROUND WATER DEPTH

Date	Depth	Elevation	Reference
1/12/2012	N/E	N/E	None Observed

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	Blows/6 in.	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
	S-1	24/20	0 - 2	5	Brown SILT, rootlets, loose, damp to frozen, ML	Lawn	TOPSOIL
1				4	Dark brown SILT, trace Sand and organics, loose,		0.7'
				5	damp, ML		
2				4			GLACIAL MARINE DEPOSITS
3							
4							
5							
	S-2	24/21	5 - 7	6	Light brown to brown medium-fine to medium-coarse		
6				8	SAND, little Silt, compact, damp, SM		
				10			
7				8			
8							
9							
10							
	S-3	24/22	10 - 12	7	Tan to light brown fine to medium-fine SAND, little		
11				8	Silt, compact, damp, SM		
				9			
12				11			
13							
14							
15							
	S-4	24/20	15 - 17	10	Tan to light brown medium-fine SAND, little Silt,		
16				12	compact, damp, SM		
				15			
17				15			
18							
19							
20							
	S - 5	24/20	20 - 22	14	Tan to light brown medium-coarse SAND, ltrace Silt,		
21				17	dense, damp to moist, SP		
				19			
22				27			

Granular Soils		Cohesive Soils		% Composition	
Blows/ft.	Density	Blows/ft.	Consistency		
0-4	V. Loose	<2	V. soft		
4-10	Loose	2-4	Soft	<5%	trace
10-30	Compact	4-8	Firm	5-15	little
30-50	Dense	8-15	Stiff	15-25	some
>50	V. Dense	15-30	V. Stiff	>25	and
		>30	Hard		

NOTES: PP = Pocket Penetrometer Resistance

Bedrock Joints
Shallow = 0 to 35 degrees
Dipping = 35 to 55 degrees
Steep = 55 to 90 degrees

Boulders = diameter > 12 inches, Cobbles = diameter < 12 inches and > 3 inches

Soil Moisture Condition
Dry: S = 0%
Humid: S = 1 to 25%
Damp: S = 26 to 50%
Moist: S = 51 to 75%
Wet: S = 76 to 99%
Saturated: S = 100%

SUMMIT
GEOENGINEERING SERVICES

SOIL BORING LOG

Boring #: **B-1**

Project: UNE Dental Building
Location: Stevens Avenue, Portland, Maine

Project #: 11296
Sheet: 2 of 2
Chkd by:

Drilling Co: Northern Test Boring
Personnel: Nick
Summit Staff: Erika Hawksley

Boring Location: Taped from existing buildings by Summit
Elevation: 128 ft +/-
Date started: 1/12/2012 Date Completed: 1/12/2012

DRILLING METHOD		SAMPLER	
Vehicle:	ATV	Type:	24" SS
Model:	Diedrich D-50	Hammer:	140 lb
Method:	2 1/4" HSA	Fall:	30"

ESTIMATED GROUND WATER DEPTH

Date	Depth	Elevation	Reference
1/12/2012	N/E	N/E	None Observed

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	Blows/6 in.	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
23							GLACIAL MARINE DEPOSITS
24							
25							24'+/- GLACIAL TILL
	S-6	24/20	25 - 27	23	Tan medium-coarse SAND, some Gravel, very dense,		
26				30	moist, SP, overlying brown medium-fine SAND,		
				32	little Silt and Gravel, very dense, moist, SM		
27				27			
28					Auger Refusal at 27.4', Probable Bedrock		27.4' PROBABLE BEDROCK
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							

Granular Soils		Cohesive Soils		% Composition	
Blows/ft.	Density	Blows/ft.	Consistency		
0-4	V. Loose	<2	V. soft		
4-10	Loose	2-4	Soft	<5%	trace
10-30	Compact	4-8	Firm	5-15	little
30-50	Dense	8-15	Stiff	15-25	some
>50	V. Dense	15-30	V. Stiff	>25	and
		>30	Hard		

NOTES: PP = Pocket Penetrometer Resistance

Bedrock Joints
Shallow = 0 to 35 degrees
Dipping = 35 to 55 degrees
Steep = 55 to 90 degrees

Boulders = diameter > 12 inches, Cobbles = diameter < 12 inches and > 3 inches

Soil Moisture Condition
Dry: S = 0%
Humid: S = 1 to 25%
Damp: S = 26 to 50%
Moist: S = 51 to 75%
Wet: S = 76 to 99%
Saturated: S = 100%

SUMMIT
GEOENGINEERING SERVICES

SOIL BORING LOG

Boring #: **B-2**

Project: UNE Dental Building
Location: Stevens Avenue, Portland, Maine

Project #: 11296
Sheet: 1 of 1
Chkd by:

Drilling Co: Northern Test Boring
Personnel: Nick
Summit Staff: Erika Hawksley

Boring Location: Taped from existing buildings by Summit
Elevation: 127 ft +/-
Date started: 1/12/2012 Date Completed: 1/12/2012

DRILLING METHOD		SAMPLER	
Vehicle:	ATV	Type:	24" SS
Model:	Diedrich D-50	Hammer:	140 lb
Method:	2 1/4" HSA	Fall:	30"

ESTIMATED GROUND WATER DEPTH

Date	Depth	Elevation	Reference
1/12/2012	N/E	N/E	None Observed

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	Blows/6 in.	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
	S-1	24/20	0 - 2	10	Dark brown SILT, rootlets, little Sand, loose to compact,	Lawn	TOPSOIL
1				2	damp to frozen, ML		
				2	Brownish orange medium-fine SAND, little Silt, loose,		1'
2				2	damp, SM		
							GLACIAL MARINE DEPOSITS
3							
4							
5							
	S-2	24/24	5 - 7	4	Brownish-orange medium-fine SAND, little Silt, loose,		
6				3	damp, SM		
				3	Light brown to tan fine SAND, little Silt, loose, damp,		
7				5	SM		
8							
9							
10							
	S-3	24/20	10 - 12	11	Light brown to tan medium-fine SAND, little Silt,		
11				12	compact, damp, SM		
				19			
12				23			
13							
14							
15							
	S-4	24/18	15 - 17	12	Same as above, compact, damp, SM		
16				17			
				21			
17				19			
18							
19							
20							
	S-5	5/5	20 - 20.4	50/5"	Same as above, light brown, dense, damp, SM		
21					Brown Silty CLAY, some Sand, little Gravel, very dense,		20.2'
					damp, CL		GLACIAL TILL
22					Auger Refusal at 20.4', Probable Bedrock		20.4'
							PROBABLE BEDROCK

Granular Soils		Cohesive Soils		% Composition	
Blows/ft.	Density	Blows/ft.	Consistency		
0-4	V. Loose	<2	V. soft		
4-10	Loose	2-4	Soft	<5%	trace
10-30	Compact	4-8	Firm	5-15	little
30-50	Dense	8-15	Stiff	15-25	some
>50	V. Dense	15-30	V. Stiff	>25	and
		>30	Hard		

NOTES: PP = Pocket Penetrometer Resistance

Bedrock Joints
Shallow = 0 to 35 degrees
Dipping = 35 to 55 degrees
Steep = 55 to 90 degrees

Boulders = diameter > 12 inches, Cobbles = diameter < 12 inches and > 3 inches

Soil Moisture Condition
Dry: S = 0%
Humid: S = 1 to 25%
Damp: S = 26 to 50%
Moist: S = 51 to 75%
Wet: S = 76 to 99%
Saturated: S = 100%

SUMMIT
GEOENGINEERING SERVICES

SOIL BORING LOG

Boring #: **B-3**

Project: UNE Dental Building
Location: Stevens Avenue, Portland, Maine

Project #: 11296
Sheet: 1 of 1
Chkd by:

Drilling Co: Northern Test Boring
Personnel: Nick
Summit Staff: Erika Hawksley

Boring Location: Taped from existing buildings by Summit
Elevation: 127 ft +/-
Date started: 1/12/2012 Date Completed: 1/12/2012

DRILLING METHOD		SAMPLER	
Vehicle:	ATV	Type:	24" SS
Model:	Diedrich D-50	Hammer:	140 lb
Method:	2 1/4" HSA	Fall:	30"

ESTIMATED GROUND WATER DEPTH

Date	Depth	Elevation	Reference
1/12/2012	N/E	N/E	Measurement in well, No water observed
1/25/2012	20.3	106.7 ft +/-	Measurement in well

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	Blows/6 in.	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
	S-1	24/20	0 - 2	10	Brown SILT, rootlets, compact, damp to frozen, ML	Lawn	TOPSOIL
1				6	Dark brown SILT, trace Sand and organics, loose		0.5'
				4	to compact, damp to frozen, ML		
2				4			GLACIAL MARINE DEPOSITS
3							
4							
5							
	S-2	24/18	5 - 7	7	Light brown to tan medium-fine to fine SAND, little		
6				7	Silt, compact, damp, SM		
				10			
7				10			
8							
9							
10							
	S-3	24/20	10 - 12	7	Light brown to tan medium-fine to medium-coarse		
11				10	SAND, little Silt, compact, damp, SM		
				15			
12				24			
13							
14							
15							
	S-4	24/16	15 - 17	15	Light brown coarse SAND, trace Silt, compact, damp,		
16				14	SP, overlying light brown fine SAND, little Silt, compact,		
				16	damp, SM		
17				19			
18							
19							
20							
	S-5	24/16	20 - 22	11	Light brown to tan medium-fine SAND, little Silt,		
21				12	compact, damp to moist, SM		
				12			
22				12			
					End of Exploration at 22', No Refusal		22'

Granular Soils		Cohesive Soils		% Composition	
Blows/ft.	Density	Blows/ft.	Consistency		
0-4	V. Loose	<2	V. soft		
4-10	Loose	2-4	Soft	<5%	trace
10-30	Compact	4-8	Firm	5-15	little
30-50	Dense	8-15	Stiff	15-25	some
>50	V. Dense	15-30	V. Stiff	>25	and
		>30	Hard		

NOTES: PP = Pocket Penetrometer Resistance

Bedrock Joints
Shallow = 0 to 35 degrees
Dipping = 35 to 55 degrees
Steep = 55 to 90 degrees

Boulders = diameter > 12 inches, Cobbles = diameter < 12 inches and > 3 inches

Soil Moisture Condition
Dry: S = 0%
Humid: S = 1 to 25%
Damp: S = 26 to 50%
Moist: S = 51 to 75%
Wet: S = 76 to 99%
Saturated: S = 100%

SUMMIT
GEOENGINEERING SERVICES

SOIL BORING LOG

Boring #: **B-4**

Project: UNE Dental Building
Location: Stevens Avenue, Portland, Maine

Project #: 11296
Sheet: 1 of 1
Chkd by:

Drilling Co: Northern Test Boring
Personnel: Nick
Summit Staff: Erika Hawksley

Boring Location: Taped from existing buildings by Summit
Elevation: 127 ft +/-
Date started: 1/12/2012 Date Completed: 1/12/2012

DRILLING METHOD		SAMPLER	
Vehicle:	ATV	Type:	24" SS
Model:	Diedrich D-50	Hammer:	140 lb
Method:	2 1/4" HSA	Fall:	30"

ESTIMATED GROUND WATER DEPTH

Date	Depth	Elevation	Reference
1/12/2012	N/E	N/E	None Observed

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	Blows/6 in.	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
	S-1	24/18	0 - 2	3	Brown SILT, rootlets, compact, damp to frozen, ML	Lawn	TOPSOIL
1				2	Dark brown SILT, trace Sand, loose, damp to frozen, ML		0.5'
				2			
2				3			GLACIAL MARINE DEPOSITS
3							
4							
5							
	S-2	24/20	5 - 7	5			
6				7	Light brown to tan medium-fine to fine SAND, little		
				10	Silt, compact, damp, SM		
7				11			
8							
9							
10							
	S-3	24/20	10 - 12	12	Light brown to tan medium-fine SAND, Little Silt,		
11				14	compact to dense, damp, SM		
				16			
12				17			
13							
14							
15							
	S-4	21/14	15 - 16.8	19	Brown fine SAND, little Silt and Gravel, very dense,		15'+/-
16				24	damp, SM		GLACIAL TILL
				30			
17				50/3"			
					Auger Refusal at 16.8', Probable Bedrock		16.8'
18							PROBABLE BEDROCK
19							
20							
21							
22							

Granular Soils		Cohesive Soils		% Composition	
Blows/ft.	Density	Blows/ft.	Consistency		
0-4	V. Loose	<2	V. soft		
4-10	Loose	2-4	Soft	<5%	trace
10-30	Compact	4-8	Firm	5-15	little
30-50	Dense	8-15	Stiff	15-25	some
>50	V. Dense	15-30	V. Stiff	>25	and
		>30	Hard		

NOTES: PP = Pocket Penetrometer Resistance

Bedrock Joints
Shallow = 0 to 35 degrees
Dipping = 35 to 55 degrees
Steep = 55 to 90 degrees

Boulders = diameter > 12 inches, Cobbles = diameter < 12 inches and > 3 inches

Soil Moisture Condition
Dry: S = 0%
Humid: S = 1 to 25%
Damp: S = 26 to 50%
Moist: S = 51 to 75%
Wet: S = 76 to 99%
Saturated: S = 100%

SUMMIT
GEOENGINEERING SERVICES

SOIL BORING LOG

Boring #: **B-5**

Project: UNE Dental Building
Location: Stevens Avenue, Portland, Maine

Project #: 11296
Sheet: 1 of 1
Chkd by:

Drilling Co: Northern Test Boring
Personnel: Nick
Summit Staff: Erika Hawksley

Boring Location: Taped from existing buildings by Summit
Elevation: 127 ft +/-
Date started: 1/12/2012 Date Completed: 1/12/2012

DRILLING METHOD		SAMPLER	
Vehicle:	ATV	Type:	24" SS
Model:	Diedrich D-50	Hammer:	140 lb
Method:	2 1/4" HSA	Fall:	30"

ESTIMATED GROUND WATER DEPTH

Date	Depth	Elevation	Reference
1/12/2012	N/E	N/E	None Observed

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	Blows/6 in.	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
					Bituminous Pavement=6"		PAVEMENT
1	S-1	24/20	0.5 - 2.5	36	Brown SAND, little Silt and Gravel, compact, damp, SM		0.5'
				15			
2				5			GLACIAL MARINE DEPOSITS
				3			
3							
4							
5							
	S-2	24/2	5 - 7	14	Rock at spoon tip, Same as above		
6				8			
				9			
7				11			
8							
9							
10							
	S-3	24/14	10 - 12	14	Light brown to tan medium-fine SAND, compact,		
11				14	damp, SP		
				18			
12				18			
13							
14							
15							
	S-4	24/14	15 - 17	12	Same as above, compact, damp, SP		
16				18			
				17			
17				16			
18							
19							
20							
	S-5	24/14	20 - 22	7	Light brown coarse SAND, compact, damp, SP,		
21				9	overlying tan fine SAND, compact, damp to moist, SP		
				11			
22				9			
					End of Exploration at 22', No Refusal		22'

Granular Soils		Cohesive Soils		% Composition	
Blows/ft.	Density	Blows/ft.	Consistency		
0-4	V. Loose	<2	V. soft		
4-10	Loose	2-4	Soft	<5%	trace
10-30	Compact	4-8	Firm	5-15	little
30-50	Dense	8-15	Stiff	15-25	some
>50	V. Dense	15-30	V. Stiff	>25	and
		>30	Hard		

NOTES: PP = Pocket Penetrometer Resistance

Bedrock Joints
Shallow = 0 to 35 degrees
Dipping = 35 to 55 degrees
Steep = 55 to 90 degrees

Boulders = diameter > 12 inches, Cobbles = diameter < 12 inches and > 3 inches

Soil Moisture Condition
Dry: S = 0%
Humid: S = 1 to 25%
Damp: S = 26 to 50%
Moist: S = 51 to 75%
Wet: S = 76 to 99%
Saturated: S = 100%

APPENDIX C

LABORATORY TESTING

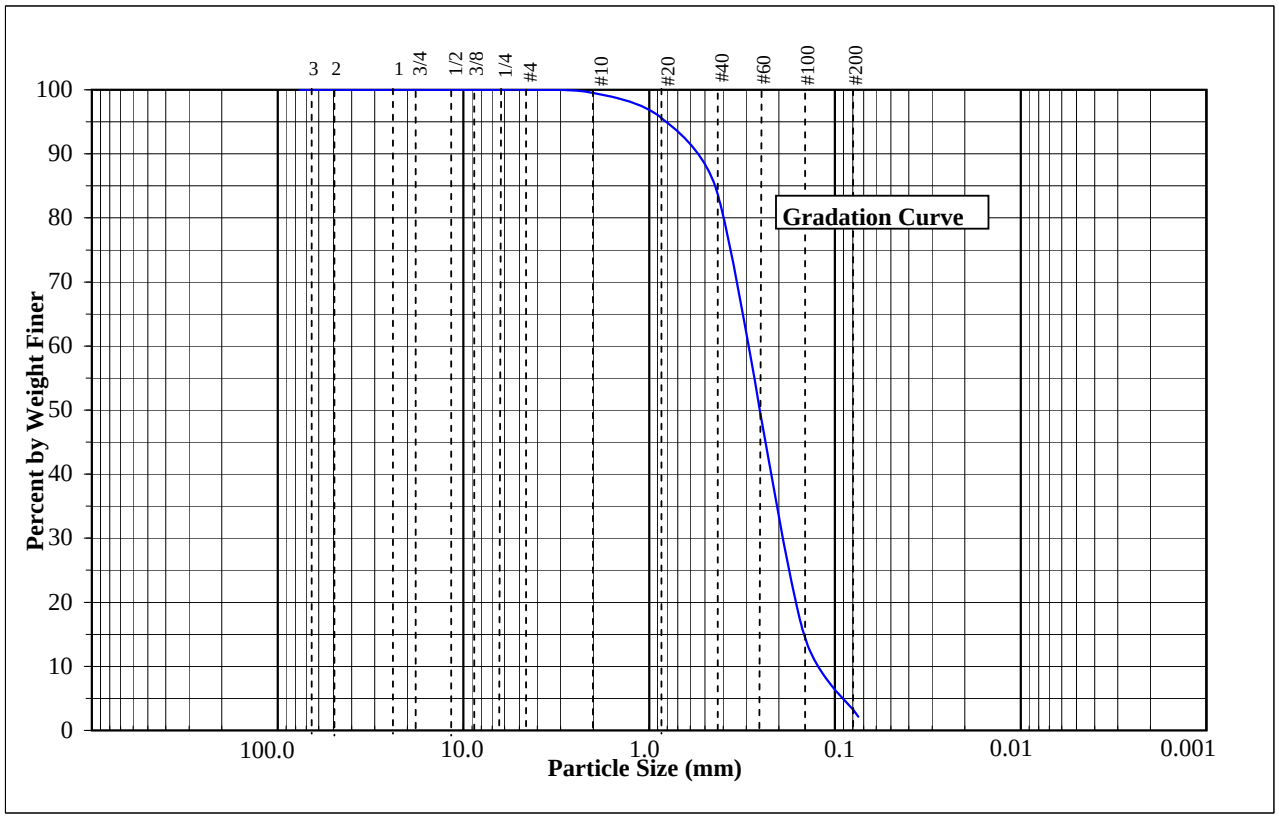
SUMMIT ENVIRONMENTAL CONSULTANTS, INC.
434 Cony Road, Augusta, Maine 04330
Phone:(207) 621-8334 Fax:(207) 626-9094

GRAIN SIZE ANALYSIS - ASTM D422

PROJECT NAME:	UNE Dental	PROJECT #:	14381 / 11296
CLIENT:	Summit Geoengineering Services	SUMMIT SAMPLE:	S2
CLIENT SOIL DES:		INTENDED USE:	Investigation
SOURCE:	B4 5-7'	SPECIFICATION:	
DATE:	January 23, 2012	TECHNICIAN:	M. Gilman

DATA

PARTICLE SIZE mm		% BY WT FINER
76.20	(3 in)	100.0
50.80	(2 in)	100.0
38.10	(1-1/2 in)	100.0
25.40	(1 in)	100.0
19.05	(3/4 in)	100.0
12.70	(1/2 in)	100.0
9.53	(3/8 in)	100.0
6.35	(1/4 in)	100.0
4.75	(No. 4)	100.0
2.00	(No. 10)	99.5
0.85	(No. 20)	95.5
0.43	(No. 40)	83.5
0.15	(No. 100)	15.9
0.08	(No. 200)	2.1



REMARKS: Moisture Content = 5.4%

Reviewed: Darrell A. Gilman, CMT Manager
Date: 1/24/12