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Gould Restaurant
Portland, Maine

Project No. 12752

September 23, 2013

Re-Issued for Construction

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PROFESSIONAL SEAL PAGE

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Architect
H A R R I M A N

LICENSED ARCHITECT
JUDY L. JOHNSON
No. 2060
STATE OF MAINE

Civil Engineer
H A R R I M A N

STATE OF MAINE
FRANK L. CRABTREE
No. 3893
LICENSED
PROFESSIONAL ENGINEER

Mechanical Engineer
H A R R I M A N

STATE OF MAINE
CLIFTON W. GREIM
No. 6405
LICENSED
PROFESSIONAL ENGINEER

Electrical Engineer
H A R R I M A N

STATE OF MAINE
JOHN W. TARR
No. 7700
LICENSED
PROFESSIONAL ENGINEER

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GOULD RESTAURANT
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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. Cover Sheet 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.

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f. Certification that Record Drawings have been updated and verifiec

2. Submit draft of [AIA Document G703 Continuation Sheets
3. Arrange the Schedule of Values in tabular form with separate columns to 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, providing at least one line item for each Specification Section. Provide several line items for principal subcontract amounts, where appropriate.
   a. For each line item, provide a sublist breakdown as follows:
      1) Material.
      2) Labor.
5. For Division 22 and 23 work, provide the following additional line item breakdown of the mechanical subcontractor's work for each Application for Payment.
   a. Ductwork Systems.
   b. HVAC Piping Systems.
   c. HVAC Equipment.
   d. HVAC Controls.
   e. Plumbing, including fixtures and piping.
6. Documentation: Submit proper documentation for the amounts being requisitioned from subcontractors and material suppliers with each Application for Payment.
7. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
8. 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.
   b. Only major long lead delivery items may be considered for off-site storage (Example: Long lead custom mechanical unit). Standard order and production materials and products shall be delivered to the site before including in Application of Payment on such items.
9. 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.
10. 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.
11. Each item in the Schedule of Values and Applications for Payment shall be complete.
    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place shall be shown as separate line items in the Schedule of Values.
12. 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.

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C. The Contractor shall furnish to the Architect at the beginning of the proj monthly requisition estimate for the Owner's use in planning funding.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications 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: Progress Payment Applications shall be submitted to Architect not less than 7 days before monthly progress meeting. The period covered by each Application for Payment is one month, ending on the last day of the month.

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

D. 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.

E. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect 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.

F. 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.

G. Record Drawing Updates: With each Application of Payment, record documents shall be maintained and current for all trades, available for viewing at a central location.

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.

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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 and other required 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.

I. Progress Applications for Payment: Administrative actions and submittals that must precede or coincide with submittal of progress Applications for Payment include the following:
   1. Contractor's Construction Schedule update.
   2. Submittals for Work being requisitioned for are complete and approved.
   3. Submit list of completed tests, checklists, commissioning, reports, and similar requirements for the work are submitted and in compliance with the Contract Documents.
   4. Minutes of previous month's progress meeting have been distributed.
   5. Record drawings are current.

J. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion less retainage, 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.

K. 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, record documents, operation and maintenance data, and demonstration and training.
   2. Mechanical commissioning completed and all systems in full compliance.
   3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
   4. Updated final statement, accounting for final changes to the Contract Sum.
   5. Waiver Forms: Submit waivers of lien on forms, and executed in a manner, acceptable to the Owner.
   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)

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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 "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
   3. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
   4. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 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 two copies.

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

E. Daily Construction Reports: Submit two copies at weekly intervals.

F. Field Condition Reports: Submit two copies at time of discovery of differing conditions.

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

1.4 COORDINATION

A. Coordinate preparation and processing of schedules and reports with 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.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE

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

B. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.
   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 major items, 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 times 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.

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D. Constraints: Include constraints and work restrictions indicated in the Contrac 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 Worl Owner.
   3. Work Stages: Indicate important stages of construction for each major p 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.
   4. 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. 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.

F. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.

2.3 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. Approximate count of personnel at Project site.
   3. Equipment at Project site.
   4. Material deliveries.
   5. High and low temperatures and general weather conditions.
   6. Accidents.
   7. Meetings and significant decisions.
   8. Unusual events (refer to special reports).
   9. Stoppages, delays, shortages, and losses.
   10. Emergency procedures.
   11. Orders and requests of authorities having jurisdiction.
   12. Change Orders received and implemented.

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13. Construction Change Directives received and implemented.
14. Services connected and disconnected.
15. Equipment or system tests and startups.
16. Partial Completions and occupancies.
17. Substantial Completions authorized.

B. 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.

2.4 SPECIAL REPORTS

A. General: Submit special reports to Architect within one day 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 biweekly intervals, update schedule to reflect actual construction progress and activities. Issue a 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.

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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. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:
1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 014000 "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
4. Section 017700 "Closeout Procedures" for submitting warranties.
5. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
6. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
7. Section 017900 "Demonstration and Training" for submitting documentation of demonstration of equipment and training of Owner's personnel.
8. Division 01 to 26 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

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1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Dra provided by Architect for Contractor's use in preparing submittals.

B. Coordination: Coordinate preparation and processing of submittals with construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Submit all submittal items required for each Specification Section concurrently.
   3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
   4. 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.
   5. No products shall be incorporated into the work unless they have been approved by the Contractor and Architect. No work will be paid for until required submittals for applicable work have been submitted and approved.

C. Processing Time: Allow 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 14 calendar days minimum 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 14 calendar days minimum 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 calendar days minimum for initial review of each submittal.

D. Electronic Submittals: **Architect is using Newforma software to process electronic submittals**. Identify and incorporate information in each electronic submittal file as follows:
   1. Assemble complete submittal package into single files incorporating submittal requirements of a single specification section and transmittal form.
      a. Provide a separate transmittal form for Product Data, a separate transmittal form for Shop Drawings, and a separate transmittal form for Informational Submittals required by each Specification Section.
      b. Maximum File Size: A single file size, up to 18 MB can be received. Contact Architect for instructions if file exceeds 18 MB.
      c. For each transmittal, attach one single PDF only. Where multiple PDFs are required for a transmittal, utilize Adobe Acrobat combine feature to merge the PDFs into a single PDF.
         1) Unacceptable Formats: In order to process the transmittals in Newforma, the single PDF file protocol must be followed. Transmittals zip files or

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grouped PDFs cannot be electronically processed and
without action for correction and resubmittal.

2) Submittals will be returned without action for correction an
   a) Submittal does not have an electronic Transmittal Fo
   b) Multiple specification sections are contained
      Transmittal form. Submittals must be separated
      Specification Sections.

2. Name file with submittal number or other unique identifier, including revision identifier.
   a. File name shall use project identifier and Specification Section number followed by a dash and then a sequential number (e.g., LNHS-061000-01). Resubmittals shall include an alphabetic suffix after another dash (e.g., LNHS-061000-01-A).
3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
   a. Project name.
   b. Date.
   c. Name and address of Architect.
   d. Name of Construction Manager.
   e. Name of Contractor.
   f. Name of firm or entity that prepared submittal.
   g. Names of subcontractor, manufacturer, and supplier.
   h. Category and type of submittal.
   i. Submittal purpose and description.
   j. Specification Section number and title.
   k. Specification paragraph number or drawing designation and generic name for each of multiple items.
   l. Drawing number and detail references, as appropriate.
   m. Location(s) where product is to be installed, as appropriate.
   n. Related physical samples submitted directly.
   o. Indication of full or partial submittal.
   p. Transmittal number.
   q. Submittal and transmittal distribution record.
   r. Other necessary identification.
   s. Remarks.

E. Options: Identify options requiring selection by Architect.

F. Deviations and Additional Information: 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 identification information as related submittal.

G. 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 with approval notation from Architect's action stamp.

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H. Distribution: Furnish copies of final submittals to manufacturers, subcontra fabricators, installers, authorities having jurisdiction, and others as necessary fo construction activities. Show distribution on transmittal forms.

I. Use for Construction: Retain complete copies of submittals on Project site action submittals that are marked with approval notation from Architect's actior

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
   1. Submit electronic submittals by either of the following methods:
      a. Via email as PDF electronic file to **submittals@harriman.com** .
         1) Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
      b. Post electronic submittals as PDF electronic files directly to Architect's FTP site specifically established for Project.
         1) Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
   2. Certificates and Certifications Submittals: Provide a 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.
      a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

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 published 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 catalog cuts.
      b. Manufacturer's product specifications.
      c. Standard color charts.
      d. Statement of compliance with specified referenced standards.
      e. Testing by recognized testing agency.
      f. Application of testing agency labels and seals.
      g. Notation of coordination requirements.
      h. Availability and delivery time information.
   4. For equipment, include the following in addition to the above, as applicable:
      a. Wiring diagrams showing factory-installed wiring.
      b. Printed performance curves.
      c. Operational range diagrams.
      d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
   5. Submit Product Data before or concurrent with Samples.
   6. Submit Product Data in the following format:

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a. PDF electronic file.

7. Do not submit Material Safety Data Sheets (MSDSs).

C. Shop Drawings: Prepare Project-specific information, drawn accurately to sc
Shop Drawings on reproductions of the Contract Documents or standard printec

1. Preparation: Fully illustrate requirements in the Contract Documen following information, as applicable:
   a. Identification of products.
   b. Schedules.
   c. Compliance with specified standards.
   d. Notation of coordination requirements.
   e. Notation of dimensions established by field measurement.
   f. Relationship and attachment to adjoining construction clearly indicated.
   g. Seal and signature of professional engineer if specified.
2. Submit Shop Drawings in the following format:
   a. PDF electronic file.

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 applicable Specification Section.
   e. Specification paragraph number and generic name of each item.
3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. 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.
5. 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.
6. 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

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color, texture, and pattern; color range sets; and components used for inc and inspection.

a. Number of Samples: Submit two sets of Samples. Architect Sample sets; remainder will be returned.

1) Submit a single Sample where assembly details, workman techniques, connections, operation, and other similar char 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: 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 indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:
   a. PDF electronic file.

F. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."

G. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

K. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."

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

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

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N. Installer Certificates: Submit written statements on manufacturer's letterhea Installer complies with requirements in the Contract Documents and, wh authorized by manufacturer for this specific Project.

O. Manufacturer Certificates: Submit written statements on manufacturer's lette that manufacturer complies with requirements in the Contract Documents. Inc manufacturing experience where required.

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

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

R. Material Test Reports: Submit 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.

S. Product Test Reports: Submit written reports indicating that 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.

T. Research Reports: Submit 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.

U. Preconstruction Test Reports: Submit 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.

V. Compatibility Test Reports: Submit 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.

W. Field Test Reports: Submit written reports 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.

X. Design Data: Prepare and submit 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.

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Include load diagrams if applicable. Provide name and version of software, calculations. Include page numbers.

Y. Material Safety Data Sheets (MSDSs): Submit information directly to Owner project; do not submit to Architect. Maintain copy at the site for the construction.
   1. Architect will not review submittals that include MSDSs and will return them.

2.2 DELEGATED-DESIGN SERVICES

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.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: 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.
   1. The Contractor shall review submittals for completeness and compliance with the Contract Documents. If submittal contains substitutions, Contractor shall process substitutions in accordance with Division 01 Section “Substitutions and Product Options,” and not part of specified Shop Drawings or Product Data submittals. Contractor is responsible for keeping Subcontractors on time with the submittal schedule. If the Contractor submits submittals that are repeatedly rejected, requiring the Architect to perform multiple reviews of the same submittal because of the failure to properly prepare and complete the submittals:
      a. Owner will compensate Architect for such additional services.
      b. Owner will deduct the amount of such compensation from the final payment to the Contractor.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

C. 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.

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3.2 ARCHITECT'S ACTION

A. Action Submittals: Architect will review each submittal, make marks to indica revisions required, and return it. Architect will stamp each submittal with an a will mark stamp appropriately to indicate action.

1. The Architect's marking of "Approved," Approved as Noted" or simila submittal has been reviewed for general conformance to the contract documents only and does not mean unqualified acceptance. The Contractor is fully responsible for compliance with the contract documents.

B. 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.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300

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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 "Construction Progress Documentation" for developing a schedule of required tests and inspections.
   2. Division 01 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
   3. Divisions 02 through 33 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.

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D. Laboratory Mockups: Full-size, physical assemblies that are constructed at t verify performance characteristics.

E. Preconstruction Testing: Tests and inspections that are performed specificall before products and materials are incorporated into the Work to verify 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.

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1.5 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assura demonstrate their capabilities and experience. Include proof of qualifications 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.

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

E. Professional Engineer Qualifications: A professional engineer who is leg practice in jurisdiction where Project is located and who is experienc 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. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. 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.

I. 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.

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J. Mockups: Before installing portions of the Work requiring mockups, build m form of construction and finish required to comply with the following req materials indicated for the completed Work:
   1. Build mockups in location and of size indicated or, if not indicated, as di Architect.
   2. Notify Architect seven days in advance of dates and times when mockup 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.

K. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 2 through 33.

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 1 Section "Submittal Procedures."

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D. Retesting/Reinspecting: Regardless of whether original tests or inspections w responsibility, provide quality-control services, including retesting and r construction that replaced Work that failed to comply with the Contract Docum

E. Testing Agency Responsibilities: Cooperate with Architect and Contractor ir 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 registered engineer to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, in compliance with applicable building code.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 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.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. 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

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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 "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
   2. Division 01 Section "Execution Requirements" for progress cleaning of Project site.
   3. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
   4. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   5. Division 1 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
   6. Divisions 02 through 33 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.
   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.

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10. Terminate and remove temporary facilities from Project site, along 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, 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. 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 INSPECTION FEES

A. If the Architect Perform Reinspections Due to Failure of the Work to Comply with the Claims of Status of Completion Made by the Contractor, Or, Should the Contractor fail to complete the work, Or, Should the Contractor fail to promptly correct warranty items or work later found to be deficient:
   1. Owner will compensate Architect for such additional services.
   2. Owner will deduct the amount of such compensation from the final payment to the Contractor.

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B. If the Work is not completed by the date set in the Agreement, and the Ar perform additional Contract Administrative and on site observation duties:
   1. Owner will compensate Architect for such additional services.
   2. Owner will deduct the amount of such compensation from the final Contractor.

1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Contractor shall 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.

1.7 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 in the contract documents.
   1. Unless indicated otherwise, all warranties shall commence on the date of Substantial Completion.

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. Submit final warranties as a package for the entire project, assembled and identified as described below.
   2. Bind warranties and bonds in heavy-duty, D-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents but not greater than 2 inches, and sized to receive 8-1/2-by-11-inch paper. Do not over fill D-ring, allowing 1/2-inch space for future additions.
   3. 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.
   4. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
   5. Electronic Media: Submit copy of warranty binder on CD-R in .PDF format. Bookmark based on the table of contents, and for each warranty within each section.

D. Provide additional electronic media copies of each warranty to include i maintenance manuals.

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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.

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 for areas disturbed and dirtied by demolition and construction 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, including walls, floors and ceilings, to a dirt-free/dust-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 created by the work 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. Resilient flooring shall be scrubbed and cleaned with specialty floor cleaner just prior to occupation by Owner.

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k. New floors shall be waxed just prior to occupation by Owner consist of three coats, properly buffed to a uniform sheen. Work s floor care subcontractor. Coordinate selection of wax with floori and Owner's maintenance program.

l. Clean transparent materials, including mirrors and glass in doo Remove glazing compounds and other noticeable, vision-obsc Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

m. Remove labels that are not permanent.

n. 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.

o. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

p. Replace parts subject to unusual operating conditions.

q. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

r. Clean ducts, blowers, and coils if units were operated without filters during construction.

s. 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.

t. 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.

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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 01 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 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
   2. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
   3. Division 01 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
   4. Divisions 02 through 33 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. Initial Submittal: Submit 1 draft copies of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return draft and mark whether general scope and content of manual are acceptable.

B. 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 copies of each corrected manual within 15 days of receipt of Architect's comments.

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1.5 COORDINATION

A. Where operation and maintenance documentation includes information on insta than one factory-authorized service representative, assemble and coordi 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 and primary subcontractors.
6. Name and address of Architect.
7. Cross-reference to related systems in other operation and maintenance manuals.

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C. Table of Contents: List each product included in manual, identified by produ
to the content of the volume, and cross-referenced to Specification Section n
Manual.
1. If operation or maintenance documentation requires more than one volun
accommodate data, include comprehensive table of contents for all volun
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, D-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents but not greater than 2 inches, 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. Do not over fill D-ring, allowing 1/2-inch space for future additions.
   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. Maximum size of drawings to be included in the binders shall not exceed 11-by-17-inch. 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 submit envelopes with manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

E. Electronic Media: Submit one copy of each complete manual, including Record Shop Drawings and Product Data on CD-R in .PDF format. Bookmark based on the specifications table of contents and manual dividers.

2.3 EMERGENCY OPERATIONS

A. Content: Include in the Operations Manual emergency information that must be immediately available during emergency situations to protect life and property and to minimize disruptions to building occupants. Include information in operations manual into a separate section for each of the following:
1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

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B. Type of Emergency: Where applicable for each type of emergency indicate instructions and procedures for each system, subsystem, piece of equipment, an
   1. Fire.
   2. Flood.
   3. Gas leak.
   4. Water leak.
   5. Power failure.
   6. Water outage.
   7. System, subsystem, or equipment failure.
   8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:
   1. Instructions on stopping.
   2. Shutdown instructions for each type of emergency.
   3. Operating instructions for conditions outside normal operating limits.
   4. Required sequences for electric or electronic systems.
   5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: Daily operations and management of systems and equipment. 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.

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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.

2.5 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.

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2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a source information, manufacturers' maintenance documentation, maintena maintenance and service schedules, spare parts list and source information, mai 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.

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PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate man 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.

G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

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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 01 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.
   4. Record Shop Drawings.

B. Related Sections include the following:
   1. Division 01 Section "Closeout Procedures" for general closeout procedures.
   2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   3. Divisions 02 through 33 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 and one copy on CD-R in .PDF format.

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

C. Record Shop Drawings and Product Data: Submit one hard copy and one copy on electronic media of each Product Data submittal.
   1. Where Record Shop Drawings and Product Data is required as part of operation and maintenance manuals, submit marked-up Shop Drawings and Product Data as an insert in manual instead of submittal as Record Shop Drawings and Product Data. Insert typewritten pages indicating drawing titles, descriptions of contents, and Record Shop Drawings and Product Data locations drawing locations that are part of operation and maintenance manuals.
   2. Electronic Media: In addition to paper copy, submit record copy of record Shop Drawings and Product Data specification on CD-R in .PDF format. Bookmark Product Data based on the table of contents.

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PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contr 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.

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2. Mark copy with the proprietary name and model number of products, ma equipment furnished, including substitutions and product options selecte
3. Record the name of manufacturer, supplier, Installer, and other informati provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has be operation and maintenance manuals instead of submitted as Record Prod
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.
6. Electronic Media: Submit record copy of record specification on CD-R in .PDF format. Bookmark based on the table of contents.

2.3 RECORD SHOP DRAWINGS AND PRODUCT DATA

A. Preparation: Mark Shop Drawings and Product Data to indicate the actual product installation where installation varies substantially from that indicated in Shop Drawings and 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.
4. Bind product data in heavy-duty, D-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents but not greater than 2 inches, and sized to receive 8-1/2-by-11-inch paper. Do not over fill D-ring, allowing 1/2 inch space for future additions.
5. Provide heavy paper dividers with plastic-covered tabs for each specification section with product data. Mark tab to identify the specification section. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
6. Identify each binder on the front and spine with the typed or printed title "PRODUCT DATA," Project name, and name of Contractor.
7. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. Maximum size of drawings to be included in the binders shall not exceed 11-by-17-inch. 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 submit envelopes with manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
8. Electronic Media: Submit record copy of marked-up Shop Drawings and Product Data on CD-R in .PDF format. Bookmark based on the table of contents, and for each Shop Drawings and Product Data within each section. Where Record Shop Drawings and Product Data is required as part of operation and maintenance manuals, submit electronic media of marked-up Shop Drawings and Product Data as part of manual instead of submittal as Record Shop Drawings and Product Data.

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.

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PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

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

B. 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 017839

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SECTION 017900 - DEMONSTRATION AND TRAINING

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 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.

B. Related Sections include the following:
   1. Division 01 Section "Project Management and Coordination" for requirements for preinstruction conferences.
   2. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

A. Demonstration and Training: Submit list of systems and equipment to be demonstrated and training provided.

1.4 COORDINATION

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

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Provide demonstration and training for each system and equipment, as required by individual Specification Sections.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training.

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3.2 DEMONSTRATION AND TRAINING INSTRUCTION

A. Engage qualified personnel to instruct Owner's personnel to adjust, operat systems, subsystems, and equipment.
   1. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide demonstration and training 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 fifteen days' advance notice.

C. Demonstration and Training: Provide instruction for equipment and systems operation. Include instruction as applicable for the following:
   1. 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. Operations manuals.
      b. Maintenance manuals.
      c. Project Record Documents.
      d. Identification systems.
      e. Warranties and bonds.
      f. Maintenance service agreements and similar continuing commitments.
   3. Emergency Operation Procedures: 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.

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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.

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SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at 414 Fore St., Portland, ME 04101, time to be determined.

1.4 INFORMATIONAL SUBMITTALS

A. Predemolition Photographs or Video: Submit before Work begins.

1.5 CLOSEOUT SUBMITTALS

A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

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1.6 QUALITY ASSURANCE

1.7 FIELD CONDITIONS

A. Owner's tenant will occupy portions of building immediately adjacent to sele area. Conduct selective demolition so Owner's tenant's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:

C. Artwork, furniture and appliances. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.

F. Storage or sale of removed items or materials on-site is not permitted.

G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1.8 WARRANTY

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

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

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B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

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g. Ducts to Be Abandoned in Place: Cap or plug ducts with sam ductwork material.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintainportable fire-suppression devices during flame-cutting operations.
4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
5. Dispose of demolished items and materials promptly

B. Removed and Salvaged Items:

1. Clean salvaged items.
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 Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

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C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reus
2. Pack or crate items after cleaning and repairing. Identify contents of cont
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requi materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

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.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

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SECTION 040110 - MASONRY CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cleaning the following:

1. Unit masonry surfaces.
2. Stone surfaces.

1.2 DEFINITIONS

A. Low-Pressure Spray: [100 to 400 psi (690 to 2750 kPa); Medium-Pressure Spray: [400 to 800 psi (2750 to 5510 kPaHigh-Pressure Spray: [800 to 1200 psi (5510 to 8250 kPa);

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at 414 Fore Street, Portland, ME, 04101

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

A. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Cleaning: Clean an area approximately 25 sq. ft. (2.3 sq. m)] for each type of masonry and surface condition.

   a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
   b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.

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PART 2 - PRODUCTS

2.1 PAINT REMOVERS

A. Covered or Skin-Forming Alkaline Paint Remover: Manufacturer's standard forming, alkaline paste or gel formulation, for removing paint from masonry; containing no methylene chloride.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABR Products, Inc.; 800 Fast Acting Grip 'N Strip.
b. Diedrich Technologies Inc., a division of Sandell Construction Solutions; 404 Rip-Strip.
c. Dumond Chemicals, Inc.; Peel Away 1.

B. Solvent-Type Paste Paint Remover: Manufacturer's standard water-rinseable, solvent-type paste or gel formulation, for removing paint from masonry.

1. Products: Subject to compliance with requirements, provide the following:

a. Diedrich Technologies Inc., a division of Sandell Construction Solutions; 505 Special Coatings Stripper.
b. Hydrochemical Techniques, Inc.; HydroClean HT-300 Solvent Paint Remover.
c. PROSOCO, Inc.; Sure Klean Fast Acting Stripper.

C. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation, for removing paint coatings from masonry; containing no methanol or methylene chloride.

1. Products: Subject to compliance with requirements, provide one of the following

a. ABR Products, Inc.; ABR Citrus Paint Removers].
b. Cathedral Stone Products, Inc.; [-301
c. Dumond Chemicals, Inc.; Peel Away 7 without paper covering
d. EaCo Chem, Inc.; InStrip.
e. PROSOCO, Inc.; Enviro Klean SafStrip

2.2 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.

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E. Acidic Cleaner: Manufacturer's standard acidic masonry cleaner composed of l
or ammonium bifluoride blended with other acids, detergents, wetting agents, a

1. Products: Subject to compliance with requirements, provide the followin

2.3 CHEMICAL CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.

B. Acidic Cleaner Solution for Unpolished Stone: Dilute acidic cleaner with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended in writing by chemical-cleaner manufacturer.

1. Stones: Use only on unpolished granite, unpolished dolomite marble, and siliceous sandstone.

PART 3 - EXECUTION

3.1 PROTECTION

A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.

3.2 CLEANING MASONRY, GENERAL

A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 50 feet (15 maway by Architect.

B. Proceed with cleaning in an orderly manner; work from bottom to topof each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.

C. Use only those cleaning methods indicated for each masonry material and location.

1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.

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2. Spray Equipment: Use spray equipment that provides controlled appli and pressure indicated, measured at nozzle. Adjust pressure and volun cleaning methods do not damage surfaces, including joints.

   a. Equip units with pressure gages.
   b. For chemical-cleaner spray application, use low-pressure tank o suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
   c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
   d. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.

E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed according to the "Cleaning Appearance Standard" Paragraph, so that cleaned surfaces blend smoothly into surrounding areas.

F. Water-Spray Application Method: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

G. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush[or spray] application. Do not spray apply at pressures exceeding 50 psi (345 kPa). Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

H. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

   1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

3.3 PRELIMINARY CLEANING

A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open joints to whatever depth they occur.

B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar.

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1. Carefully remove heavy accumulations of rigid materials from maso sharp chisel. Do not scratch or chip masonry surface.
2. Remove paint and calking with alkaline paint remover .

    a. Comply with requirements in "Paint Removal" Article.
    b. Repeat application up to two times if needed.

3. Remove asphalt and tar with solvent-type paste paint remover.

    a. Comply with requirements in "Paint Removal" Article.
    b. Apply paint remover only to asphalt and tar by brush without pre-wetting.
    c. Allow paint remover to remain on surface for 10 to 30 minutes.
    d. Repeat application if needed.

3.4 PAINT REMOVAL

A. Paint-Remover Application, General: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

B. Paint Removal with Covered or Skin-Forming Alkaline Paint Remover:

1. Remove loose and peeling paint using lowpressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with coldwater applied by lowpressure spray to remove chemicals and paint residue.
7. Apply acidic cleaner or manufacturer's recommended afterwash to surface, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or afterwash remain on surface as a neutralizing agent for period recommended by chemical-cleaner or afterwash manufacturer.
8. Rinse with cold water applied by lowpressure spray to remove chemicals and soil.
9. Retreat spots of remaining paint.

C. Paint Removal with Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using lowpressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to painted surface with natural-fiber cleaning brush, deep-nap roller, or large paint brush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with coldwater applied by pressure spray to remove chemicals and paint residue.

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3.5 CLEANING MASONRY

A. Acidic Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surfaceby brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer >.
4. Rinse with cold water applied by lowpressure spray to remove chemicals and soil. Rinse until all foaming, if any, stops and suds disappear.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

END OF SECTION 040110

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SECTION 055170 - ALTERNATING TREAD STEEL STAIRS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A.Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY:

A. Provide all material, labor, equipment and services and perform all operations necessary or required for the work of this section, in accordance with the Drawings and Specifications, and including fabrication and installation of Alternating Tread Steel Stairs.

B. Related work specified elsewhere includes but is not limited to:
1. Conventional Metal Stairs in another Division 5 section
2. Metal Fabrications in another Division 5 section
3. Painting in Division 9

1.3 PERFORMANCE REQUIREMENTS:

A. Stair Treads: shall be capable of withstanding a single concentrated 1000 pound load without permanent deformation.
B. Handrail: shall be capable of withstanding a single concentrated load of 200 pounds or a uniform load of 50 pounds per linear foot applied in any direction at any point on the rail.

1.4 CONSTRUCTION REQUIREMENTS:

A. Landings, Treads, and Mounting Base: shall be stamped and formed from single piece material. Stock shapes, hand forming, or welded remnants shall not be permitted. All stamped parts shall have integrally formed rigidizing bends and shall be spot welded to stringers of like material.

B. Welds: shall be a minimum of 6 welds per tread, and 12 welds each on the landing and footing. Each weld shall be quality controlled and be capable of withstanding a minimum of 2800 lbs. in shear.

C. Pedestrian Surfaces: shall be punched through with upset non-skid openings.

D. Riser Spacing: shall be equally spaced to within 3/16" for adjacent risers and to within 3/8" for any two non-adjacent risers on a stair.

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E. Handrails: shall be contoured for body guidance and underarm support and shall be att
outside stringers and landings by bolting.

F. Landing Reinforcement: shall be with minimum .20" (0.51 cm) steel formed angle not
punched and factory welded to the landing at the points of a handrail attachment.

G. Rubber Foot Divider: shall be affixed to the central portion of the landing. A rubber bumper strip shall be attached or will be provided for field attaching to the central stringer.

1.5 DIMENSIONS:

A. Stair Angle: [56] or [68] degrees from horizontal as specified in the drawings.

B. Vertical Drop: the change in elevation, as shown in the drawings, between the upper finished floor surface where the top landing will be attached and the lower finished floor surface where the base of the stair will be secured.

1.6 SUBMITTALS:

Dimensional Prints: shall be submitted for approval prior to fabrication.

PART 2- PRODUCTS

B. Substitutions will not be considered.

2.2 MATERIALS:
A. Carbon Steel:
1. Treads: 13 Gauge 1010/15 HRPO per ASTM A569
2. Landing & Foot Stampings: 11 Gauge 1010/15 per ASTM A569
3. Stringers:
a. 2" x 1 3/4" x 11 Gauge 1010/15 per ASTM A569 for 56 degree stairs under 10 vertical feet and for 68 degree stairs under 12 vertical feet.
b. 3" x 1 3/4" x 11 Gauge 1010/15 for 56 degree stairs over 10 vertical feet and for 68 degree stairs over 12 vertical feet.
4. Handrails: 1 1/2" OD x 0.083" 1010/15 CS per ASTM A569 cold drawn, fully annealed tube per ASTM 513.

B. Stainless Steel:
1. Treads: 13 Gauge 304 SS
2. Landing & Foot Stampings: 11 Gauge 304 SS
3. Stringers:
a. 2" x 1 3/4" x 11 Gauge 304 SS for 56 degree stairs under 10 vertical feet and for 68 degree stairs under 12 vertical feet.
b. 3" x 1 3/4" x 11 Gauge 304 SS 56 degree for stairs over 10 vertical feet and for 68 degree stairs over 12

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vertical feet.
4. Handrails: 1 1/2" OD x 0.065" 304 SS cold drawn, fully annealed tube per ASTM A51

C. Miscellaneous Material:
1. Rubber Spine: Hollow neoprene
2. Rubber Foot Divider: Solid neoprene

2.3 FINISHES:
A. Carbon Steel:
1. Iron Grey Powder Coat Baked Enamel

2.4 FABRICATION:

General: Fabricate alternating tread steel stairs to conform with performance and construction requirements, and in accordance with approved shop drawings or dimensional prints. Fabricate and shop-assemble to greatest extent possible.

A. Carbon Steel: gas metal arc welded with treads spot welded to stringers and bolt-on handrails with included bolts using the specified materials.

B. Stainless Steel: gas tungsten arc welded and/or gas metal arc welded with treads spot welded to stringers and bolt-on handrails with included bolts using the specified materials.

PART 3- EXECUTION:

3.1 PREPARATIONS:

A. Coordination: Coordinate start and installation of steel alternating treads with all other related and adjacent work. Installation shall not start until the construction has progressed to the point that weather conditions and remaining construction operations will not damage stair installation.

B. Verification: Verify that dimensions and angle are correct and that substrate is in proper condition for stair installation. Do not proceed to install until all necessary corrections have been made.

3.2 INSTALLATION:

A. If bumper has not been installed at the factory, install the self adhesive bumper.

B. Prepare mounting holes.

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C. Position stair with top tread at same elevation as upper finished floor or roof surface.

D. Secure stair with not less than 2 bolts or studs at top and with not less than 2 at bottom of stair.

E. Touch up with matching paint any chipped or abraded damage to factory finish or

F. Touch up any damage to galvanized surfaces using galvanized repair paint in accordance with ASTM A780.

3.3 CLEAN:

Leave work area clean and free of debris

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SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe railings.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel Pipe and Tube Railings:

1. Manufacturers: Subject to compliance with requirementsavailable manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

   a. Wagner, R & B, Inc.

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2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in "Quality Requirements," to design railings, including attachment to building co

B. Structural Performance: Railings, including attachment to building constructior the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

2.3 METALS, GENERAL

A. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with predrilled hole for exposed bolt anchorageand that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.4 STEEL AND IRON

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than25percent.

B. Tubing: ASTM A 500 (cold formed

C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

2.5 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.

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3. .

B. Post-Installed Anchors: Torque-controlled expansion anchorscapable of sus failure, a load equal to 6 times the load imposed when installed in unit masonr load imposed when installed in concrete, as determined by testing ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

F. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

2.7 FABRICATION

A. 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.

B. Form work true to line and level with accurate angles and surfaces.

C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

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.

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D. Welded Connections for Aluminum Pipe: Fabricate railings to interconnec concealed internal welds that eliminate surface grinding, using manufacturer's of sleeve and socket fittings.

E. Nonwelded Connections: Connect members with concealed mechanical faste Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

F. Form changes in direction by inserting prefabricated elbow fittings.

G. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

H. Close exposed ends of railing members with prefabricated end fittings.

I. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

J. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

2.8 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exteriorsteel railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.

B. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," 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.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

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1. Do not weld, cut, or abrade surfaces of railing components that are cc after fabrication and that are intended for field connection by mechanica 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 variatic with rake of steps and ramps for sloping members do not exceed 1/4 i mm in 3.5 m).

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

3.2 ATTACHING RAILINGS

A. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

B. Secure wall brackets and railing end flanges 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 studs or wood backing between studs. Coordinate with carpentry work to locate backing members.

3.3 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 requirements for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

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SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Shear wall panels.
4. Rooftop equipment bases and support curbs.
5. Wood blocking and nailers.
6. Wood furring.
7. Wood sleepers.
8. Plywood backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

1.3 INFORMATIONAL SUBMITTALS

A. 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.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Shear panels.
5. Power-driven fasteners.
6. Powder-actuated fasteners.
7. Expansion anchors.
8. Metal framing anchors.

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PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Certified Wood: Materials shall be produced from wood obtained from forest FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship" for the following:

1. Dimension lumber framing.
2. Laminated-veneer lumber.
3. Parallel-strand lumber.
4. Prefabricated wood I-joists.
5. Rim boards.
6. Miscellaneous lumber.

B. 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, mark grade stamp on end or back of each piece
3. Provide dressed lumber, S4S, unless otherwise indicated.

C. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

D. 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 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

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B. Kiln-dry lumber after treatment to a maximum moisture content of 19 per material that is warped or that does not comply with requirements for untreated

C. Mark lumber with treatment quality mark of an inspection agency approved by of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat items indicated on Drawings, and the following:

1. Framing for raised platforms.
2. Framing for stages.
3. Concealed blocking.

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4. Framing for non-load-bearing partitions.
5. Framing for non-load-bearing exterior walls.
6. Roof construction.
7. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.

1. Application: Interior partitions not indicated as load-bearing.
2. Species:

   a. Mixed southern pine; SPIB.
   b. Northern species; NLGA.
   c. Eastern softwoods; NeLMA.
   d. Western woods; WCLIB or WWPA.

B. Framing Other Than Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.

1. Application: Framing other than interior partitions not indicated as load-bearing.
2. Species:

   a. Hem-fir (north); NLGA.
   b. Southern pine; SPIB.
   c. Douglas fir-larch; WCLIB or WWPA.
   d. Mixed southern pine; SPIB.
   e. Spruce-pine-fir; NLGA.
   f. Douglas fir-south; WWPA.
   g. Hem-fir; WCLIB or WWPA.
   h. Douglas fir-larch (north); NLGA.
   i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. Framing Other Than Non-Load-Bearing Interior Partitions: Any species and grade with a modulus of elasticity of at least 1,500,000 psi (10 350 MPaand an extreme fiber stress in bending of at least 1000 psi (6.9 MPafor 2-inch nominal (38-mm actual) thickness and 12-inch nominal (286-mm actual) width for single-member use.

1. Application: Framing other than interior partitions not indicated as load-bearing.

2.5 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.

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6. Grounds.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumbe

C. For concealed boards, provide lumber with 15 percent maximum moisture following species and grades:

1. Mixed southern pine; No. 2grade; SPIB.
2. Eastern softwoods; No. 2Common grade; NeLMA.
3. Northern species; No. 2Common grade; NLGA.
4. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

2.6 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exterior, AC in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 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

B. Power-Driven Fasteners: NES NER-272.

C. 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.

2.8 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Cleveland Steel Specialty Co.
2. KC Metals Products, Inc.
3. Phoenix Metal Products, Inc.
4. Simpson Strong-Tie Co., Inc.
5. USP Structural Connectors.

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C. Allowable Design Loads: Provide products with allowable design loads, manufacturer that meet or exceed those of products of manufacturers listed published values shall be determined from empirical data or by rational engi and demonstrated by comprehensive testing performed by a qualified ind agency.

D. 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 unless otherwise indicated.

E. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for wood-preservative-treated lumber and where indicated.

2.9 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.

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 furring, nailers, blocking, grounds and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's WCD 1, "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. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

E. Shear Wall Panels: Install shear wall panels to comply with manufacturer's written instructions.

F. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

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G. Do not splice structural members between supports unless otherwise indicated.

H. Comply with AWPA M4 for applying field treatment to cut surfaces of pres lumber.

I. Where wood-preservative-treated lumber is installed adjacent to metal continuous flexible flashing separator between wood and metal decking.

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 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.

3.2 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 sufficiently wet that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

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SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Composite nail base insulated roof sheathing.
4. Subflooring.
5. Underlayment.
6. Sheathing joint and penetration treatment.

1.2 ACTION 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 plywood complies with requirements.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For following products, from ICC-ES:

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Foam-plastic sheathing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

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2.2 WOOD PANEL PRODUCTS

A. Emissions: Products shall meet the testing and product requirements o Department of Health Services' "Standard Practice for the Testing of V Emissions from Various Sources Using Small-Scale Environmental Chambers.'

B. Certified Wood: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":

1. Plywood.
2. Oriented strand board.
3. Particleboard underlayment.
4. Hardboard underlayment.

C. Plywood: Either DOC PS 1 or DOC PS 2 unless otherwise indicated.

D. Oriented Strand Board: DOC PS 2.

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

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3. Design Value Adjustment Factors: Treated lumber plywood shall be t ASTM D 5516 and design value adjustment factors shall be calculat ASTM D 6305. Span ratings after treatment shall be not less than span ra

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat all plywood unless otherwise indicated.

2.5 WALL SHEATHING

A. Plywood Wall Sheathing: Exterior, Structural Isheathing.

B. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I sheathing.

C. Cementitious Backer Units: ASTM C 1325, Type A.

1. Thickness: [1/2 inch (12.7 mm)] [5/8 inch (15.9 mm)

2.6 SUBFLOORING AND UNDERLAYMENT

A. Plywood Combination Subfloor-Underlayment: DOC PS 1, Exposure 1, Underlayment single-floor panels.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M

2.8 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

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PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces tha use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by 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 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."

D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Combination Subfloor-Underlayment:

a. Glue and nail to wood framing.
b. Screw to cold-formed metal framing.
c. Space panels 1/8 inch (3 mm) apart at edges and ends.

2. Subflooring:

a. Glue and nail to wood framing.
b. Screw to cold-formed metal framing.
c. Space panels 1/8 inch (3 mm) apart at edges and ends.

3. Wall and Roof Sheathing:

a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
b. Screw to cold-formed metal framing.
c. Space panels 1/8 inch (3 mm) apart at edges and ends.

4. Underlayment:

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a. Nail or staple to subflooring.
b. Space panels 1/32 inch (0.8 mm) apart at edges and ends.
c. Fill and sand edge joints of underlayment receiving resilient floor before installing flooring.

C. Seal sheathing joints according to sheathing manufacturer's written instructions

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.3 CEMENTITIOUS BACKER UNIT INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

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SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim.
2. Shelving
3. Interior stairs

B. Related Requirements:

1. Section 064214 "Stile and Rail Wood Paneling."
2. Section 064300 "Wood Stairs and Railings."
3. Section 064400 "Ornamental Woodwork."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Samples: For each type of paneling.

PART 2 - PRODUCTS

2.1 INTERIOR TRIM

A. Softwood Lumber Trim:

B. Hardwood Lumber Trim:

1. Species and Grade: Red oak Clear NHLA.
2. Maximum Moisture Content: 9 percent.

C. Hardwood Moldings for Transparent Finish (Stain or Clear Finish): WMMPA HWM 2, N-grade wood moldings made to patterns included in WMMPA HWM 1.

1. Species: Hard pine
2. Maximum Moisture Content: 9 percent.

D. Molding Patterns:

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2.2 PANELING

A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood

2.3 SHELVING

A. Shelving: Made from the following material 3/4 inch (19 mm) thick.

1. MDF with solid-wood front edge.

2.4 STAIRS AND RAILINGS

A. Treads: 1-1/16-inch (27-mm), clear, kiln-dried, edge-glued, hard pine stepping Risers: 13/16-inch (21-mm), clear, kiln-dried, edge-glued hard pine stock.

2.5 MISCELLANEOUS MATERIALS

A. Low-Emitting Materials: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

1. Wood glue shall have a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Paneling Adhesive: Comply with paneling manufacturer's written recommendations for adhesives.

1. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.2 INSTALLATION, GENERAL

A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

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1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish recommended by manufacturer.
2. Countersink fasteners, fill surface flush, and sand unless otherwise indica
3. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for l Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) max flush installation and 1/16-inch (1.5-mm) maximum offset for reveal inst
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.

3.3 STANDING AND RUNNING TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.

3.4 SHELVING INSTALLATION

A. Cut shelf cleats at ends of shelves about 1/2 inch (13 mm) less than width of shelves and sand exposed ends smooth.

B. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled. Space fasteners not more than 16 inches (400 mm) o.c.

C. Install shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches (900 mm) o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

D. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled. Install shelves, fully seated on cleats, brackets, and supports.

E. Cantilever Wall Shelving to be installed using brackets bolted to wall. Toggle bolts to be used in gypsum board wall, metal anchors to be used in masonry.

3.5 STAIR AND RAILING INSTALLATION

A. Treads and Risers at Interior Stairs: Secure treads and risers by gluing and nailing to rough carriages.
   1. Open Stringers: Miter risers and stringer at open stringers. Extend tread over open stringers and finish with bullnose edge.

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SECTION 064300 - WOOD STAIRS AND RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood stairs
2. Shop finishing of wood stairs and railings.

1.2 ACTION SUBMITTALS

A. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

B. Samples:

1. Shop-applied transparent finishes.
2. Shop-applied opaque finishes.

1.3 INFORMATIONAL SUBMITTALS

A. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wood stairs and railings 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.

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PART 2 - PRODUCTS

2.1 WOODWORK FABRICATORS

2.2 WOOD STAIRS AND RAILINGS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide labels from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.

B. Grade: Custom

C. Wood for Transparent Finish: hard pine treads

D. Wood for Opaque Finish: hard pine. Finishes for Stair Parts: As follows:

1. Treads: Transparent
2. Risers: Transparent.
3. Stringers: Transparent.
4. Scotia, Cove, and Other Moldings: Transparent.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 4 to 9 percent.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Rough Carriages for Stairs: Laminated veneer lumber, made with an exterior-type adhesive complying with ASTM D 2559, and with the following allowable design values as determined according to ASTM D 5456:

1. Extreme Fiber Stress in Bending, Edgewise: 3100 psi (21.3 MPa for 12-inch nominal-(286-mm actual-) depth members.
2. Modulus of Elasticity, Edgewise: 2,000,000 psi (13 800 MPa).

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

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D. Adhesives: Do not use adhesives that contain urea formaldehyde.

E. Adhesives: Use adhesives that meet the testing and product requirements (Department of Health Services' "Standard Practice for the Testing of V Emissions from Various Sources Using Small-Scale Environmental Chambers.'

F. VOC Limits for Installation Adhesives and Sealants: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Multipurpose Construction Adhesives: 70 g/L.
3. Structural Wood Member Adhesive: 140 g/L.

2.5 FABRICATION

A. Fabricate wood stairs and railings to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.

B. 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.

C. Cut carriages to accurately fit treads and risers. Glue treads to risers, and glue and nail treads and risers to carriages.

1. Fabricate stairs with treads and risers no more than 1/8 inch (3 mm) from indicated position and no more than 1/16 inch (1.5 mm) out of relative position for adjacent treads and risers.

2.6 SHOP FINISHING

A. General: Finish wood stairs and railings at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Finish Materials: Use finish materials that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

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.

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D. Transparent Finish:

1. Grade: Custom.
2. Finish: System - 11, catalyzed polyurethane.
3. Sheen: Flat, 15-30 gloss units measured on 60-degree gloss meter per AS

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition wood stairs to average prevailing humidity conditions in installation areas.

3.2 INSTALLATION

A. Grade: Install wood stairs to comply with same grade as item to be installed.

B. Stairs: Securely anchor carriages to supporting substrates. Install stairs with treads and risers no more than 1/8 inch (3 mm) from indicated position.

C. Railings:

END OF SECTION 064300

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SECTION 064600 - WOOD TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior standing and running trim.
2. Interior standing and running trim.
3. Closet and utility shelving.
4. Wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.
5. Shop priming of wood trim.
6. Shop finishing of wood trim.

1.2 ACTION SUBMITTALS

A. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

B. Samples:

1. Lumber for transparent finish, for each species and cut, finished on one side and one edge.
2. Lumber and panel products with shop-applied opaque finish, for each finish system and color, with exposed surface finished.

1.3 INFORMATIONAL SUBMITTALS

A. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

1.5 FIELD CONDITIONS

A. Weather Limitations for Exterior Work: Proceed with installation of exterior wood trim only when existing and forecasted weather conditions permit work to be performed and at least one coat of specified finish to be applied without exposure to rain, snow, or dampness.

B. Environmental Limitations for Interior Work: Do not deliver or install interior building is enclosed, wet work is complete, and HVAC system is operating temperature and relative humidity at occupancy levels during the remainder of period.

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PART 2 - PRODUCTS

2.1 WOOD TRIM FABRICATORS

2.2 WOOD TRIM, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of wood trim indicated for construction, finishes, installation, and other requirements.

1. Provide labels from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.

2.3 EXTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Grade: Custom

B. Wood Species: Hard Pine.

2.4 EXTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Grade: Custom

B. Wood Species: Hard Pine

2.5 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Grade: Custom

1. Species: Hard Pine
2. Cut: Plain Sawn

2.6 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Grade: Custom

B. Wood Species: Hard Pine

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2.7 CLOSET AND UTILITY SHELVING

A. Grade: Custom.

B. Shelf Material: 3/4-inch (19-mm) medium-density fiberboard with solid-lumber

C. Cleats: 3/4-inch (19-mm) solid lumber.

D. Wood Species: Hard Pine

2.8 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of wood trim and quality grade specified unless otherwise indicated.

1. Wood Moisture Content for Exterior Materials: 7 to 12 percent.
2. Wood Moisture Content for Interior Materials: 4 to 9 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of wood trim and quality grade specified unless otherwise indicated.

1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
2. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
3. Medium-Density Fiberboard: ANSI A208.2, Grade 130 made with binder containing no urea formaldehyde.

C. Water-Repellent Preservative Treated Materials: Comply with AWPA N1 (dip, spray, flood, or vacuum-pressure treatment) for exterior wood trim indicated to receive water-repellent preservative treatment.

1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC), combined with an insecticide containing chloropyrifos (CPF).
2. Extent of Water-Repellent Preservative Treatment: Treat all exterior wood trim unless otherwise indicated.

2.9 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

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B. Fire-Retardant-Treated Lumber: Products with a flame-spread index of 25 or according to ASTM E 84, with no evidence of significant progressive combust is extended an additional 20 minutes, and with the flame front not extending m (3.2 m) beyond the centerline of the burners at any time during the test.

1. For exterior applications, use materials that comply with testing require subjected to accelerated weathering according to ASTM D 2898.
2. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.

2.10 MISCELLANEOUS MATERIALS

A. Exterior Blocking, Shims, and Nailers: Softwood or hardwood lumber, pressure-preservative treated kiln dried to less than 15 percent moisture content.

1. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3b.

a. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.
b. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.

B. Interior Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber kiln dried to less than 15 percent moisture content.

C. Nails for Exterior Use: stainless steel.

D. Screws for Exterior Use: stainless steel.

E. Provide self-drilling screws for metal-framing supports.

F. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

G. Adhesives: Do not use adhesives that contain urea formaldehyde.

H. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

I. VOC Limits for Installation Adhesives and Sealants: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Multipurpose Construction Adhesives: 70 g/L.
3. Structural Wood Member Adhesive: 140 g/L.
4. Architectural Sealants: 250 g/L.

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2.11 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed fabrication.

B. Fabricate wood trim to dimensions, profiles, and details indicated. Ease indicated for the following:

1. Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
2. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).

C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members except for members with ends exposed in finished work.

D. Assemble casings in shop except where shipping limitations require field assembly.

2.12 SHOP PRIMING

A. Exterior Wood Trim for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099113 "Exterior Painting."

B. Exterior Wood Trim for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."

C. Interior Wood Trim for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099123 "Interior Painting."

D. Interior Wood Trim for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."

E. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood trim, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood trim. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

2.13 SHOP FINISHING

A. General: Finish wood trim at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Section 099113 "Exterior Painting"

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Section 099123 "Interior Painting" and Section 099300 "Staining and Transp
for field finishing wood trim not indicated to be shop finished.

C. Finish Materials: Use finish materials that meet the testing and product req
California Department of Health Services' "Standard Practice for the Tes
Organic Emissions from Various Sources Using Small-Scale Environmental Ch

D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood trim, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood trim. Apply two coats to end-grain surfaces.

E. Transparent Finish for Exterior Trim: Comply with Section 099300 "Staining and Transparent Finishing."

F. Opaque Finish for Exterior Trim: Comply with Section 099113 "Exterior Painting."

G. Transparent Finish for Interior Trim:

1. Grade: Custom Economy.
2. Finish: System - 11, catalyzed polyurethane.
3. Staining: None required
4. Sheen: Flat, 15-30gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition wood trim to average prevailing humidity conditions in installation areas.

3.2 INSTALLATION

A. Grade: Install wood trim to comply with same grade as item to be installed.

B. Install wood trim level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

C. Scribe and cut wood trim to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

D. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

E. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes according to AWPA M4.

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F. Anchor wood trim to anchors or blocking built in or directly attached to substr countersunk, concealed fasteners and blind nailing. Use fine finishing nails[or for exposed fastening, countersunk and filled flush with woodwork.

1. For shop-finished items, use filler matching finish of items being installe

G. 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 long except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

1. Install wall railings on indicated metal brackets securely fastened to wall framing.
2. 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).

END OF SECTION 064600

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SECTION 064800 - WOOD FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior frames and jambs.
2. Interior frames and jambs.

1.2 ACTION SUBMITTALS

A. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

B. Samples:

1. Lumber for transparent finish, for each species and cut, finished on one side and one edge.
2. Lumber with shop-applied opaque finish, for each finish system and color, with exposed surface finished.

1.3 INFORMATIONAL SUBMITTALS

A. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program

B. Installer Qualifications: Fabricator of products.

1.5 FIELD CONDITIONS

A. Weather Limitations for Exterior Work: Proceed with installation of exterior wood frames only when existing and forecasted weather conditions permit work to be performed and at least one coat of specified finish to be applied without exposure to rain, snow, or dampness.

B. Environmental Limitations for Interior Work: Do not deliver or install interior wood frames 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.

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PART 2 - PRODUCTS

2.1 WOOD FRAME FABRICATORS

2.2 WOOD FRAMES, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of wood frames indicated for construction, finishes, installation, and other requirements.

1. Provide labels from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.

2.3 EXTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH

A. Grade: Custom

B. Wood Species: Any closed-grain hardwood

2.4 INTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH

A. Grade: Custom

B. Wood Species: Any closed-grain hardwood.

2.5 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of wood frame and quality grade specified unless otherwise indicated.

1. Wood Moisture Content for Exterior Materials: 7 to 12 percent.
2. Wood Moisture Content for Interior Materials: 4 to 9 percent.

2.6 MISCELLANEOUS MATERIALS

A. Exterior Blocking, Shims, and Nailers: Softwood or hardwood lumber pressure-preservative treated, kiln dried to less than 15 percent moisture content.

1. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3b.

a. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.
b. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.

B. Interior Blocking, Shims, and Nailers: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

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C. Nails for Exterior Use: stainless steel.

D. Screws for Exterior Use: stainless steel.

E. Provide self-drilling screws for metal-framing supports.

F. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

G. Adhesives: Do not use adhesives that contain urea formaldehyde.

H. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 FABRICATION

A. Fabricate wood frames to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.

2.8 SHOP PRIMING

A. Exterior Wood Frames for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099113 "Exterior Painting."

B. Exterior Wood Frames for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."

C. Interior Wood Frames for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099123 "Interior Painting."

D. Interior Wood Frames for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."

E. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood frames, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood trim. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

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2.9 SHOP FINISHING

A. General: Finish wood frames at fabrication shop as specified in this Section. touchup, cleaning, and polishing until after installation.

B. General: Drawings indicate items that are required to be shop finished. Fini fabrication shop as specified in this Section. Refer to Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099300 "Staining and Transparent Finishing" for field finishing wood frames not indicated to be shop finished.

C. Finish Materials: Use finish materials that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood frames, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood frames. Apply two coats to end-grain surfaces.

E. Transparent Finish for Exterior Frames: Comply with Section 099300 "Staining and Transparent Finishing."

F. Opaque Finish for Exterior Frames: Comply with Section 099113 "Exterior Painting."

G. Opaque Finish for Interior Frames:

1. Grade: Custom
2. Finish: System - 4, water-based latex acrylic
3. Color: As selected by Architect from manufacturer's full range
4. Sheen: Semigloss, 46-60 gloss units measured on 60-degree gloss meter per ASTM D 523

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition wood frames to average prevailing humidity conditions in installation areas.

3.2 INSTALLATION

A. Grade: Install wood frames to comply with same grade as item to be installed.

B. Install wood frames level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

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C. Scribe and cut wood frames to fit adjoining work, refinish cut surfaces, and finish at cuts.

D. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated with chemical treatment manufacturer's written instructions, including those fc to install woodwork.

E. Anchor wood frames to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

1. For shop-finished items, use filler matching finish of items being installed.

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SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes plastic sheet paneling.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For plastic paneling and trim accessories.

1.3 QUALITY ASSURANCE

A. Testing Agency: Acceptable to authorities having jurisdiction

PART 2 - PRODUCTS

2.1 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319. Panels shall be USDA accepted for incidental food contact.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Standard FRP Panel or comparable product by one of the following:

   a. Crane Composites, Inc.
   b. Glasteel.
   c. Marlite.
   d. Newcourt, Inc.
   e. Nudo Products, Inc.
   f. Parkland Plastics, Inc.

3. Low-Emitting Materials: Paneling shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.

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a. Flame-Spread Index: [25] [200] <Insert value> or less.
b. Smoke-Developed Index: 450 or less.

5. Nominal Thickness: Not less than [0.09 inch (2.3 mm.
6. Surface Finish: Molded pebble texture.
7. Color: Grey.

2.2 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: Grey.

B. Adhesive: As recommended by plastic paneling manufacturer and with a VOC content of 50g/L or less.

C. Adhesive: As recommended by plastic paneling manufacturer and that complies with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

1. Sealant shall have a VOC content of 250 g/L or less.
2. Sealant shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

B. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

C. Lay out paneling before installing. Locate panel joints so that trimmed panels at corners are not less than 12 inches wide.

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3.2 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with adhesive staples Do not fasten through panels.

D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

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SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Mineral-wool blanket insulation.
2. Spray polyurethane foam insulation.
3.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Research/evaluation reports.

PART 2 - PRODUCTS

2.1 MINERAL-WOOL BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fibrex Insulations Inc.
2. Owens Corning.
3. Roxul Inc.
4. Thermafiber.
5.

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.

C. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

D. Reinforced-Foil-Faced, Mineral-Wool Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less per ASTM E 84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

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2.2 SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with r spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E

1. Manufacturers: Subject to compliance with requirements, provide produ following

a. BASF Corporation.
b. BaySystems NorthAmerica, LLC.
c. Dow Chemical Company (The).
d. ERSystems, Inc.
e. Gaco Western Inc.
f. Henry Company.
g. NCFI; Division of Barnhardt Mfg. Co.
h. SWD Urethane Company.
i. Volatile Free, Inc.

2. Minimum density of 1.5 lb/cu. ft. (24 kg/cu. m), thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F (43 K x m/W at 24 deg C).

B. Open-Cell Polyurethane Foam Insulation: Spray-applied polyurethane foam using water as a blowing agent, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

a. BaySystems NorthAmerica, LLC.
b. Demilec (USA) LLC.
c. Gaco Western Inc.
d. Icynene Inc.
e. SWD Urethane Company.

2. Minimum density of 0.4 lb/cu. ft. (6.4 kg/cu. m), thermal resistivity of 3.4 deg F x h x sq. ft./Btu x in. at 75 deg F (24 K x m/W at 24 deg C).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

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D. Provide sizes to fit applications indicated and selected from manufac thicknesses, widths, and lengths. Apply single layer of insulation units to pr indicated unless multiple layers are otherwise shown or required to make up tot

3.2 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

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.

B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
6. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:

    a. With faced blankets having stapling flanges, secure insulation by inset, stapling flanges to sides of framing members.
    b. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

    a. Exterior Walls: Set units with facing placed toward interior of construction.
    b. Interior Walls: Set units with facing placed toward areas of high humidity.

C. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

D. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Loose-Fill Insulation: Compact to approximately 40 percent of normal m
   equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
2. Spray Polyurethane Insulation: Apply according to manufacturer's writte

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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes hollow-metal work.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required.

E. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Amweld International, LLC.
2. Apex Industries, Inc.
3. Ceco Door Products; an Assa Abloy Group company.
4. Commercial Door & Hardware Inc.
5. Concept Frames, Inc.
6. Curries Company; an Assa Abloy Group company.
7. Custom Metal Products.

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8. Daybar.
9. Deansteel.
10. de La Fontaine Industries.
11. DKS Steel Door & Frame Sys. Inc.
12. Door Components, Inc.
13. Fleming-Baron Door Products.
14. Gensteel Doors Inc.
15. Greensteel Industries, Ltd.
16. HMF Express.
17. Hollow Metal Inc.
18. Hollow Metal Xpress.
19. J/R Metal Frames Manufacturing, Inc.
20. Karpen Steel Custom Doors & Frames.
21. L.I.F. Industries, Inc.
22. LaForce, Inc.
23. Megamet Industries, Inc.
24. Mesker Door Inc.
25. Michbi Doors Inc.
26. MPI Group, LLC (The).
27. National Custom Hollow Metal.
28. North American Door Corp.
29. Philipp Manufacturing Co (The).
30. Pioneer Industries, Inc.
31. Premier Products, Inc.
32. Republic Doors and Frames.
33. Rocky Mountain Metals, Inc.
34. Security Metal Products Corp.
35. Shanahans Manufacturing Ltd.
36. Steelcraft; an Ingersoll-Rand company.
37. Steward Steel; Door Division.
38. Stiles Custom Metal, Inc.
39. Titan Metal Products, Inc.
40. Trillium Steel Doors Limited.
41. West Central Mfg. Inc.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and 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 257 or UL 9.

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2.3 INTERIOR DOORS AND FRAMES

A. Standard-Duty Doors and Frames: SDI A250.8, Level 1. At locations indicated Frame Schedule

1. Physical Performance: Level C according to SDI A250.4.

2. Frames:

a. Materials: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
b. Construction: Knocked down.

3. Exposed Finish: Prime

2.4 FRAME ANCHORS

A. Jamb Anchors:
1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.

2.5 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25percent.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

G. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.

2.6 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical,

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fit and assemble units in manufacturer's plant. To ensure proper assembly clearly identify work that cannot be permanently factory assembled before ship

B. Hollow-Metal Frames: Where frames are fabricated in sections due to ship limitations, provide alignment plates or angles at each joint, fabricated of sam as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
4. Jamb Anchors: Provide number and spacing of anchors as follows:

   a. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

      1) Three anchors per jamb up to 60 inches (1524 mm) high.
      2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
      3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
      4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.

5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.

   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.

C. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

2.7 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: SDI A250.10.

B. Factory Finish: SDI A250.3.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicat SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

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-rated openings, install frames according to NFPA 80.
   b. Where frames are fabricated in sections because of 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 stops located on secure side of opening.
   d. Install door silencers in frames before grouting.
   e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   g.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post installed expansion anchors.

   a. Floor anchors may be set with power-actuated fasteners instead of post installed expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
6. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

   a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

3.2 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace

defective work, including hollow-metal work that is warped, bowec unacceptable.

B. Remove grout and other bonding material from hollow-metal work in installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

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SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Solid-core doors with wood-veneer faces.
2. Hollow-core doors with wood-veneer faces.
3. Factory finishing flush wood doors.
4. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 083473.16 "Wood Sound Control Door Assemblies" for acoustic flush wood doors.
2. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of door. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

C. Samples: For factory-finished doors.

1.3 INFORMATIONAL SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is a certified participant in AWI's Quality Certification Program.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products following:

1. Algoma Hardwoods, Inc.
2. Ampco.
3. Chappell Door Co.
4. Eggers Industries.
5. General Veneer Manufacturing Co.
6. Graham Wood Doors; an Assa Abloy Group company.
7. Haley Brothers, Inc.
8. Ipik Door Company.
9. Lambton Doors.
10. Marlite.
11. Marshfield Door Systems, Inc.
12. Mohawk Doors; a Masonite company.
13. Oshkosh Door Company.
14. Poncraft Door Company.
15. Vancouver Door Company.
16. VT Industries, Inc.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with Architectural Woodwork Standards."

1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.

B. Regional Materials: Flush wood doors shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

C. Regional Materials: Flush wood doors shall be manufactured within 500 miles (800 km) of Project site.

D. Certified Wood: Flush wood doors shall be certified as "FSC Pure" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

E. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.

F. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that comply with the testing and product requirements of the California Department of Health

Services' "Standard Practice for the Testing of Volatile Organic Emission Sources Using Small-Scale Environmental Chambers."

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G. Structural-Composite-Lumber-Core Doors:
   1. Structural Composite Lumber: WDMA I.S.10.
      a. Screw Withdrawal, Face: 700 lbf (3100 N).
      b. Screw Withdrawal, Edge: 400 lbf (1780 N).

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

   1. Grade: Custom (Grade A faces).
   2. Species: Red oak.
   3. Cut: Rotary cut.
   4. Match between Veneer Leaves: Pleasing match.
   5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
   6. Core: Either glued or nonglued wood stave or structural composite lumber.
   7. Construction: Seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
   8. Construction: Seven plies, either bonded or nonbonded construction.

2.4 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
   1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

C. Openings: Factory cut and trim openings through doors.
   1. Light Openings: Trim openings with moldings of material and profile indicated.
   2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
   3. Louvers: Factory install louvers in prepared openings

2.5 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
   1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors that are indicated to receive transparent finish.

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C. Use only paints and coatings that comply with the testing and product requ
California Department of Health Services' "Standard Practice for the Tes
Organic Emissions from Various Sources Using Small-Scale Environmental Ch

D. Transparent Finish:

1. Grade: Custom.
2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 5, conversion varnish.
3. Finish: WDMA TR-4 conversion varnish.
4. Staining: None required.
5. Effect: Filled finish.
6. Sheen: Satin.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hardware: For installation, see Section 087100 - Door Hardware.

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.

a. Comply with NFPA 80 for fire-rated doors.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Mechanical door hardware for the following:
      a. Swinging doors.
      b. Sliding doors.
      c. Folding doors.
   2. Cylinders for door hardware specified in other Sections.

B. Products furnished, but not installed, under this Section include the products listed below. Coordinating and scheduling the purchase and delivery of these products remain requirements of this Section.
   1. Thresholds to be installed under other Sections.
   2. Permanent lock cores to be installed by Owner.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each exposed product and for each color and texture specified.

C. Other Action Submittals:
   1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
      a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
      b. Content: Include the following information:
         1) Identification number, location, hand, fire rating, size, and material of each door and frame.
         2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
         3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
         4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.

   2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

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1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged covering for storage and identified with labels describing contents.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:

1. For door hardware, an Architectural Hardware Consultant (AHC).

C. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.

D. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.

E. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

F. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
2. Comply with the following maximum opening-force requirements:
   a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
   b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
   c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

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G. Keying Conference: Conduct conference at Project site to comply with Section 013100 "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

B. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
   a. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled on Drawings to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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2. Basis-of-Design Product: Subject to compliance with requirements, indicated on Drawingsor comparable product by one of the following:
   a. Baldwin Hardware Corporation.
   b. Bommer Industries, Inc.
   c. Cal-Royal Products, Inc.
   d. Hager Companies.
   e. IVES Hardware; an Ingersoll-Rand company.
   f. Lawrence Hardware Inc.
   g. McKinney Products Company; an ASSA ABLOY Group company.
   h. PBB, Inc.
   i. Stanley Commercial Hardware; Div. of The Stanley Works.

B. Pin-and-Barrel-Type Hinges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
   a. Hager Companies.
   b. IVES Hardware; an Ingersoll-Rand company.
   c. Lawrence Hardware Inc.
   d. Markar Architectural Products, Inc.; a subsidiary of Adams Rite Manufacturing Co.
   e. McKinney Products Company; an ASSA ABLOY Group company.
   f. Select Products Limited.
   g. Zero International.

2.3 MECHANICAL LOCKS AND LATCHES

A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

B. Bored Locks: BHMA A156.2; Grade 1Series 4000.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Arrow USA; an ASSA ABLOY Group company.
   b. Best Access Systems; Div. of Stanley Security Solutions, Inc.
   c. Cal-Royal Products, Inc.
   d. Corbin Russwin Architectural Hardware; n ASSA ABLOY Group Company.

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e. Falcon Lock; An Ingersoll-Rand Company.
f. K2 Commercial Hardware; a Black & Decker Corp. company.
g. Marks USA.
h. Medeco Security Locks, Inc.; an ASSA ABLOY Group company.
i. PDQ Manufacturing.
j. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
k. Schlage Commercial Lock Division; an Ingersoll-Rand company.
l. Weiser Lock Corp.; a Black & Decker Corp. company.
m. Yale Security Inc.; an ASSA ABLOY Group company.

C. Mortise Locks: BHMA A156.13; Operational Grade 1 stamped steel case with steel or brass parts; Series 1000.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
   a. Accurate Lock & Hardware Co.
   b. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
   c. Arrow USA; an ASSA ABLOY Group company.
   d. Best Access Systems; Div. of Stanley Security Solutions, Inc.
   e. Cal-Royal Products, Inc.
   f. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
   g. Falcon Lock; an Ingersoll-Rand company.
   h. Marks USA.
   i. PDQ Manufacturing.
   j. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
   k. Schlage Commercial Lock Division; an Ingersoll-Rand company.
   l. Yale Security Inc.; an ASSA ABLOY Group company.

2.4 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Manufacturer: Same manufacturer as for locking devices.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following
3. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated schedule or comparable product by one of the following:
   a. Arrow USA; an ASSA ABLOY Group company.
   b. ASSA, Inc.; An ASSA ABLOY Group Company.
   c. Best Access Systems; Div. of Stanley Security Solutions, Inc.
   d. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
   e. Falcon Lock; an Ingersoll-Rand company.
   f. Medeco Security Locks, Inc.; an ASSA ABLOY Group company.
   g. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
   h. Schlage Commercial Lock Division; an Ingersoll-Rand company.
   i. Yale Security Inc.; an ASSA ABLOY Group company.

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B. Construction Master Keys: Provide cylinders with feature that permits voiding keys without cylinder removal. Provide 10 construction master keys.

C. Construction Cores: Provide construction cores that are replaceable by p Provide 10 construction master keys.

2.5 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
   1. Master Key System: Change keys and a master key operate cylinders.

B. Keys: Brass.

   1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
      a. Notation: "DO NOT DUPLICATE".

   2. Quantity: In addition to one extra key blank for each lock, provide the following:
      a. Master Keys: Five.

2.6 OPERATING TRIM

A. Operating Trim: BHMA A156.6; bronze, unless otherwise indicated.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Burns Manufacturing Incorporated.
      b. Don-Jo Mfg., Inc.
      c. Forms + Surfaces.
      d. Hager Companies.
      e. Hiawatha, Inc.
      f. IVES Hardware; an Ingersoll-Rand company.
      g. Rockwood Manufacturing Company.
      h. Trimco.

2.7 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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2. Basis-of-Design Product: Subject to compliance with requirements, indicated on schedule or comparable product by one of the following:
   a. Arrow USA; an ASSA ABLOY Group company.
   b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Grou
   c. DORMA Architectural Hardware; Member of The DORM America.
   d. Dor-O-Matic; an Ingersoll-Rand company.
   e. K2 Commercial Hardware; a Black & Decker Corp. company.
   f. LCN Closers; an Ingersoll-Rand company.
   g. Norton Door Controls; an ASSA ABLOY Group company.
   h. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
   i. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
   j. Yale Security Inc.; an ASSA ABLOY Group company.

2.8 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16; bronze, base metal.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
   a. Architectural Builders Hardware Mfg., Inc.
   b. Baldwin Hardware Corporation.
   c. Burns Manufacturing Incorporated.
   d. Cal-Royal Products, Inc.
   e. Don-Jo Mfg., Inc.
   f. Door Controls International, Inc .
   g. Hager Companies.
   h. Hiawatha, Inc.
   i. IVES Hardware; an Ingersoll-Rand company.
   j. Rockwood Manufacturing Company.
   k. Stanley Commercial Hardware; Div. of The Stanley Works.
   l. Trimco.

2.9 SLIDING DOOR HARDWARE

A. Sliding Door Hardware: BHMA A156.14; consisting of complete sets including rails, hangers, supports, bumpers, floor guides, and accessories indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
   a. Cox, Arthur, & Sons, Inc.
   b. Hager Companies.
   c. Henderson, PC Inc.
   d. Johnson, L. E., Products, Inc.
   e. Stanley Commercial Hardware; Div. of The Stanley Works.

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f. Leatherneck Hardware, Inc. #402 Flat Track Hanger Door Assemb

2.10 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published ter for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:
   a. Wood or Machine Screws: For the following:
      1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
      2) Strike plates to frames.
      3) Closers to doors and frames.
   b. Steel Through Bolts: For the following unless door blocking is provided:
      1) Surface hinges to doors.
      2) Closers to doors and frames.
      3) Surface-mounted exit devices.
3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.11 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

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B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforc for Mineral Core Wood Flush Doors."

C. Mounting Heights: Mount door hardware units at heights to comply with the otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

E. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

F. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).

G. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.
2. Furnish permanent cores to Owner for installation.

H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant.

I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

J. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

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3.2 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Owner will engage a qualif Architectural Hardware Consultant to perform inspections and to prepare inspe

3.3 DOOR HARDWARE SCHEDULE

HW1

Doors A105 & A204
Each door to have: Sliding Barn Door Hardware, Privacy Set

HW2

Door A001
Door to have: Hinges, Lockset (Function 2), Wall Stop, Silencers

HW3

Door A101A
Door to have: Hinges, Passage Set (Function 3), Closer, Kick Plate, Wall Stop, Silencers

Doors A101 & A202
Existing Hardware to Remain

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SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Glass for storefront framing.
2. Glazing sealants and accessories.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Preconstruction adhesion and compatibility test report.

1.5 QUALITY ASSURANCE

A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

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1. Testing is not required if data are submitted based on previous testing c products and glazing materials matching those submitted.

1.7 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

   1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to 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. Warranty Period: Five years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to 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.

   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Glass Product: Subject to compliance with requirements, provide product indicated in glass schedules or comparable product by one of the following:

   1. AGC Glass Company North America, Inc.
   2. Berkowitz, JE, LP.
   3. Cardinal Glass Industries.
   4. Cristacurva Glass.
   5. Dlubak Corporation.
   6. Gardner Glass Products, Inc.
   7. General Glass International.
   8. Glasswerks LA, Inc.
   9. Glaz-Tech Industries.
   10. Guardian Industries Corp.

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11. Hartung Glass Industries.
12. Northwestern Industries, Inc.
13. Oldcastle BuildingEnvelope.
14. Pilkington North America Inc.
15. PPG Industries, Inc.
16. Saint-Gobain Corporation.
17. Schott North America, Inc.
18. Tecnoglass S. A.
19. Trulite Glass & Aluminum Solutions.
20. Viracon, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E 1300.

1. Design Wind Pressures: As indicated on Drawings.
2. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Windborne-Debris-Impact Resistance: Exterior glazing shall comply with basic protection testing requirements in ASTM E 1996 for Wind Zone 3when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located more than 30 feet (9.1 m) above grade.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

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2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass produ and organizations below unless more stringent requirements are indic publications for glazing terms not otherwise defined in this Section or in referer

1. GANA Publications:"Laminated Glazing Reference Manual" and "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of manufacturer Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum .Provide glass that complies with performance requirements and is not less than the thickness indicated

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provides heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

1. Sealing System: Dual seals.
2. Spacer: Manufacturer's standard spacer material and construction

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates,

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under conditions of service and application, as demonstrated by seala based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written selecting glazing sealants suitable for applications indicated and for conc time of installation.
3. Field-applied sealants shall have a VOC content of not more than 250 g/l
4. Sealants shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following

   a. Dow Corning Corporation; 790.
   b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
   c. May National Associates, Inc.; Bondaflex Sil 290.
   d. Pecora Corporation; 890NST.
   e. Sika Corporation U.S.; Sikasil WS-290.
   f. Tremco Incorporated; Spectrem 1.

2. Applications: <at three (3) existing openings at Wharf Street Level. >.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following

   a. Dow Corning Corporation; 995.
   b. GE Advanced Materials - Silicones; Contractors N SCS1800May National Associates, Inc.; Bondaflex Sil 295.
   c. Pecora Corporation; 864NST
   d. Polymeric Systems, Inc.; PSI-641.
   e. Sika Corporation U.S.; Sikasil WS-295.
   f. Tremco Incorporated; Spectrem 2

2. Applications: < At three (3) existing openings at Wharf Street Level. >.

D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Bostik, Inc.; Chem-Calk 1250.
   b. Dow Corning Corporation; 1199
   c. GE Advanced Materials - Silicones; SilGlaze II SCS2811
   d. May National Associates, Inc.; Bondaflex Sil 201 FC.

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e. Polymeric Systems, Inc.; PSI-631.
f. Schnee-Morehead, Inc., an ITW company; SM5731 Poly-Glaze Pl
g. Sika Corporation U.S.; Sikasil-N Plus US.
h. Tremco Incorporated; Tremsil 600.
i. >.

2. Applications: < At three (3) existing openings at Wharf Street Level.>.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; 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; 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.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

E. 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.

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PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, g glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. 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.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

G. 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.

3.2 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, then to jambs. Cover horizontal framing joints by applying tapes to jambs, 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. Apply heel bead of elastomeric sealant.

F. 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.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

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3.3 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit c with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is secu joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: 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. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. 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.

   1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

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3.6 INSULATING GLASS SCHEDULE

A. Glass Type [GL-<1>]: Clear insulating glass.

1. Basis-of-Design Product: < Guardian Glass >.
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 3 mmOutdoor LiteFully tempered float glass.
4. Interspace Content: Argon.
5. Indoor Lite: Fully tempered float glass.
6. Safety glazing required.

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SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fixed, formed-metal louvers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

C. Samples: For each type of metal finish required.

D. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on tests performed according to AMCA 500-L.

B. Windborne-debris-impact-resistance test reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

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2. Wind Loads: Determine loads based on a uniform pressure of 20 lbf/sq.
inward or outward.

C. Windborne-Debris-Impact Resistance: Louvers located within 30 feet (9.1 r
pass basic]-protection, large-missile testing requirements in ASTM E 1
Zone 3when tested according to ASTM E 1886. Test specimens shall be no sma
length than louvers indicated for use on Project.

D. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Component Importance Factor: 1.0.

E. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

2.2 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Drainable-Blade Louver:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawingsor comparable product by one of the following:

a. Air Balance Inc.; a Mestek company.
b. Air Flow Company, Inc.
c. Airolite Company, LLC (The).
d. All-Lite Architectural Products.
e. American Warming and Ventilating; a Mestek company.
f. Architectural Louvers; Harray, LLC.
g. Arrow United Industries; a division of Mestek, Inc.
h. Carnes Company, Inc.
i. Cesco Products; a division of Mestek, Inc.
j. Construction Specialties, Inc.
k. Dowco Products Group; Safe Air of Illinois.
l. Greenheck Fan Corporation.
m. Industrial Louvers, Inc.
n. Louvers & Dampers; a division of Mestek, Inc.
o. Metal Form Manufacturing, Inc.
p. NCA Manufacturing, Inc.
q. Nystrom, Inc.
r. Pottorff.
s. Reliable Products, Inc.
t. Ruskin Company; Tomkins PLC.
u. United Enertech.
v. Vent Products Co., Inc.

3. Louver Depth: 4 inches (100 mm).

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4. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 m
   0.080 inch (2.03 mm) for frames.
5. Mullion Type: Exposed.
6. Louver Performance Ratings:

   a. Free Area: Not less than 8.0 sq. ft. (0.74 sq. m) for 48-inch- (122
      48-inch- (1220-mm-) high louver.
   b. Point of Beginning Water Penetration: Not less than 900 fpm (4.6 m/s).
   c. Air Performance: Not more than 0.10-inch wg (25-Pa static pressure drop at 700-fpm (3.6-m/s free-area intake velocity).

7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.3 LOUVER SCREENS

A. General: Provide screen at each exterior louver

   1. Screen Location for Fixed Louvers: Interior face.
   2. Screening Type: Bird screening.

B. Louver Screen Frames: Same type and form of metal as indicated for louver to which screens are attached.

C. Louver Screening for Aluminum Louvers:

   1. Bird Screening: Aluminum, 1/2-inch- (13-mm-) square mesh, 0.063-inch (1.60-mm) wire.

2.4 MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

   1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
   2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
   3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
   4. For fastening stainless steel, use 300 series stainless-steel fasteners.
   5. For color-finished louvers, use fasteners with heads that match color of louvers.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

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2.5 FABRICATION

A. Fabricate frames, including integral sills, to fit in openings of sizes indicated, made for fabrication and installation tolerances, adjoining material tolerance sealant joints.

B. Join frame members to each other and to fixed louver blades with fillet welds concealed from view threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.6 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611or thicker.

1. Color: Black
2. Color: As selected by Architect from full range of industry colors and color densities.

2.7 GALVANIZED-STEEL SHEET FINISHES

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and place louvers 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 weather tight connection.

C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

3.2 ADJUSTING

A. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

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SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Low Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 GYPSUM BOARD, GENERAL

A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

C. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site.

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2.3 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide products following:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. National Gypsum Company.
5. USG Corporation.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered.

C. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; FiberCement Underlayment.
   b. Custom Building Products; Wonderboard
   c. James Hardie Building Products, Inc.; Hardiebacker.
   d. National Gypsum Company, Permabase Cement Board.
   e. USG Corporation; DUROCK Cement Board.

2. Thickness: 5/8 inch (15.9 mm.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

B. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Gypsum.
   b. CertainTeed Corp.
   c. Georgia-Pacific Gypsum LLC.
   d. USG Corporation.

2. Core: 5/8 inch (15.9 mm), Type X.

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2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.

B. Aluminum Trim: ASTM B 221 (ASTM B 221M), Alloy 6063-T5.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.7 AUXILIARY MATERIALS

A. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Laminating adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

C. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

D. Vapor Retarder: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

A. Comply with ASTM C 840.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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C. Isolate perimeter of gypsum board applied to non-load-bearing partitio abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide locations and trim edges with edge trim where edges of panels are exposed. Se edges and abutting structural surfaces with acoustical sealant.

D. Install trim with back flanges intended for fasteners, attach to framing with san for panels. Otherwise, attach trim according to manufacturer's written instructions.

1. Aluminum Trim: Install in locations as required.
2. Control Joints: Install control joints at locations indicated on Drawings according to ASTM C 840 and in specific locations approved by Architect for visual effect.

E. Prefill open joints and damaged surface areas.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Where indicated on Drawings.
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

5. Level 5: Where indicated on Drawings.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

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SECTION 093100 – TILE

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. Quarry tile.
2. Paver tile (porcelain tile).
3. Waterproof membrane for thin-set tile installations.
4. Crack-suppression membrane for thin-set tile installations.
5. Cementitious backer units installed as part of tile installations.
6. Tile underlayment.
7. Metal edge strips installed as part of tile installations.

B. Related Sections include the following:
1. Division 02 Section "Selective Demolition and Alterations" for removing existing finishes.
2. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
3. Division 09 Section "Gypsum Board Assemblies" for moisture and mold-resistant board and glass-mat, water-resistant backer board.

1.3 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

B. Product Data: For each type of product indicated.

C. 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.

D. Samples for Verification:
1. Full-size units of each type and composition of tile and for each color and finish required. For glass mosaic tile in color blend patterns, provide full sheets of each color blend.
2. Metal edge strips in 6-inch lengths.

1.4 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.

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B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a for each mortar, adhesive, and grout component from a single manufacturer an from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products Section through one source from a single manufacturer for each product:
   1. Crack-suppression membrane.
   2. Metal edge strips.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
   1. Assemble all trades working at Project site to coordinate the work and to prevent workers from walking on newly installed tiles for required setting bed and grout cure times. Large tile will require additional time for the mortar bed to cure. Contractor to coordinate project schedule to complete work by other trades and vacate areas receiving floor coverings, stopping pedestrian traffic over newly installed flooring installation until curing and drying period is complete. Contractor shall conduct periodic coordination meetings with all trades to review schedule and procedures to prevent interference and damage during installation and curing and drying periods of floor coverings.

1.5 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.
   1. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient and substrate temperatures and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.
   1. Maintain temperatures at 50 deg F or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.

1.7 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

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1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 pe installed, for each type, composition, color, patter, and size indicated.

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. Products: Subject to compliance with requirements, provide one of the products specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the 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.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, 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.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.
   1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 TILE PRODUCTS

A. Unglazed Quarry Tile [**QT-**1]: Square-edged flat tile as follows:
   1. Face Size: 66 by 6 inches6.
   2. Thickness: **1/2 inch**.
   3. Wearing Surface: **Nonabrasive, smooth**.
   4. Face: Flashed.
   5. Finish: Unfinished.
   6. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable **and matching characteristics of adjoining flat tile**. Provide shapes as follows, selected from manufacturer's standard shapes:
      a. Base: Sanitary Coved with surface bullnose top edge(Q-3565U), face size 5 by 6 inches.
      b.
   7. Products:

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a. American Olean – Quarry Naturals
b. Color: N56 Shadow Flash

B. Trim Units for Ceramic Tile: Provide tile trim units to match characteristics tile and to comply with the following requirements:
1. Size: As indicated, coordinated with sizes and coursing of adjoining applicable.
2. Shapes: As follows, selected from manufacturer's standard shapes:
a. Ceramic Tile Base: Internal coved corner, exterior bull-nosed corner.
1) Sanitary Cove Base: S366C9T.

C. Floor Tile (Porcelain Tile)CT-1: Flat tile as follows:
1. Composition: Porcelain.
2. Face Size: 6- by 24-inches. (304.8mm x 304.8 mm)
3. Thickness: 3/8 inch (9.525 mm)
4. Face: Plain with square edges.
5. Product: American Olean: Avenue One.
a. Color: AU05 Brownstone.

D. Stone Thresholds
1. General: Provide stone thresholds that are uniform in color and finish, fabricated to sizes and profiles indicated to provide transition between tile surfaces and adjoining finished floor surfaces.
a. Fabricate thresholds minimum 5/8 inches thick with no more than ½ inch (12.7 mm) above adjoining finished floor surfaces, with transition edges beveled on a slope no greater than 1:2.

2.4 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes. Provide stone that is uniform in color and finish.
1. Bevel edges at 1:2 slope, aligning lower edge of bevel with adjacent floor finish. Limit height of bevel to 1/2 inch or less, and finish bevel to match face of threshold.

B. Slate Thresholds: ASTM C 629, Classification **I Exterior**, with fine, even grain and honed finish.
1. Description: Uniform, **black and unfading**.

2.5 CRACK ISOLATION MEMBRANE FOR THIN-SET TILE INSTALLATIONS

A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of a two-part, liquid rubber and fabric reinforcement, with a VOC content of 65 g/L or less when calculated according to South Coast Air Quality Management district (SCAQMD) Rule 1168 as amended January 7, 2005.
1. Product: Laticrete International, Inc.; Laticrete Blue 92 Anti-Fracture Membrane.
a. Location: Use under entire porcelain and quarry tile installation.

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2.6 SETTING AND GROUTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the fol
   1. Prepackaged dry-mortar mix combined with acrylic resin liquid-latex adc VOC content of 65 g/L or less when calculated according to South Coast Management district (SCAQMD) Rule 1168 as amended January 7, 2005
      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.
      b. Provide white mortar for use with glass tile mosaics.
   2. Product: LATICRETE International Inc.; Laticrete 254 Platinum.

B. Chemical-Resistant, Water-Cleanable, Grouting Epoxy: ANSI A118.3 , with a VOC content of 65 g/L or less when calculated according to South Coast Air Quality Management district (SCAQMD) Rule 1168 as amended January 7, 2005.
   1. Product: LATICRETE International Inc.; SpectaLOCK PRO Grout.
      a. Grout Colors, GR-1, 2 & 3: As indicated on Materials Legend; in locations not indicated, as selected by Architect from manufacturer's full range of colors.

2.7 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the 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 South Coast Air Quality Management district (SCAQMD) Rule 1168 as amended January 7, 2005.
   2. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

2.8 MISCELLANEOUS MATERIALS

A. Trowelable Under-layments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Polyethylene Membrane: ASTM D 4397, 6 mils thick, with maximum permeance rating of 0.08 perm.

C. Metal Edge Strips: Stainless steel terrazzo strips, 1/8-inch wide at top edge with integral provision for anchorage to mortar bed or substrate unless otherwise indicated.
   1. Provide at tile to carpet locations and where indicated.
   2. Product: Schluter Systems L.P.; Schluter-Schiene E Series.

D. Control Joints (CJ): Control joints for porcelain tile, thermoplastic movement joint with opposing metal profiles.
   1. Product: Schluter DILEX-KS.

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E. Tile Cleaner: A neutral cleaner capable of removing soil and residue without l grout surfaces, specifically approved for materials and installations indicated b manufacturers.

2.9 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions, including those for accurate proportioning of materials, water, or additive content; type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

B. 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. Check flatness of substrate by laser. Level floor to provide a base for thin set that allows for a smooth, flat floor without irregularities.
   2. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
   3. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
      a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
      b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
   4. 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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Shot blast existing concrete floors to remove existing adhesives.

B. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

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C. Fill cracks, holes, and depressions in concrete substrates for tile floors installec mortar with trowelable leveling and patching compound specifically recomme setting material manufacturer.

D. Blending: For tile exhibiting color variations, verify that tile has been factory packaged so tile units taken from one package show same range of colors as th 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 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. Lay tile in patterns indicated. When field conditions conflict with indicated pattern, notify Architect in writing prior to installation for review and approval of revisions.

D. 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.

E. 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. Top setting of coved base is not permitted.

F. Tile shall lay flat and each edge flush with adjacent tile, free of tilting and skewed tile. Provide additional setting material to shim accent tiles that are thinner than field tiles so face is in same plane.

G. 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.

H. Lay out tile wainscots to next full tile beyond dimensions indicated.

I. 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.
   1. Locate expansion joints in accordance with approved Shop Drawings.
   2. Space joints no greater than 36 feet apart, 16 feet apart at areas exposed to direct sunlight.
   3. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

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J. Grout tile to comply with requirements of the following tile installation standa
   1. For ceramic tile grouts (latex-portland cement grouts), comply with ANS

3.4 CRACK-SUPPRESSION MEMBRANE INSTALLATION

A. Install crack-suppression membrane to comply with ANSI A108.17 and manuf instructions to produce membrane of uniform thickness bonded securely to substrate.
   1. Seal perimeter of room by running crack-suppression membrane up wall 2 inches minimum and onto floor 4 inches minimum.

3.5 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.
   1. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.
      a. Tile floors composed of tiles 8 by 8 inches or larger.

B. Joint Widths: Install tile on floors with the following joint widths:
   1. Quarry Tile: **3/8 inch**.
   2. Floor Tile (Porcelain Tile): 1/8 inch.

3.6 CLEANING AND PROTECTING

A. Remove and replace material that is stained or otherwise damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove 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.

C. 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.

D. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

E. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.7 TILE INSTALLATION SCHEDULE

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A. Paver Tile (Porcelain Tile) Floor Tile over Concrete Floor: Thin-set latex port mortar tile setting bed over anti-fracture membrane applied to saw cuts and ran epoxy gout; TCA F125.
   1. At toilet and shower areas, seal perimeter of room by running anti-fractu wall 2 inches minimum and onto floor 2 inches minimum.

B. Porcelain Wall Tile on Moisture- and Mold-Resistant Gypsum Wallboard: Latex portland cement mortar tile setting bed with epoxy grout, TCA W243.

C. Porcelain Wall Tile on Glass-Mat, Water Resistant Backer Board: Latex portland cement mortar tile setting bed with epoxy grout, TCA W245.

END OF SECTION 093100

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SECTION 099000 - PAINTING

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. Exposed exterior items and surfaces with low VOC coatings complying with ME DEP regulations.
   2. Exposed interior items and surfaces with low VOC coatings complying with ME DEP regulations.
   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 06 Section "Finish Carpentry" for surface preparation of exterior standing and running trim, siding, and finish carpentry.
   2. Division 06 “Architectural Woodwork” for millwork and other millwork.
   3. Division 08 Section "Steel Doors and Frames" for factory priming steel doors and frames.
   4. Division 09 Section "Gypsum Board Assemblies" for surface preparation of gypsum board.
   5. Review all sections for shop primed items requiring field painting.

1.3 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.

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

B. Product Data: For each paint system indicated, including block fillers and primers.
   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.

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2. Manufacturer's Information: Manufacturer's technical information, inclu analysis and instructions for handling, storing, and applying each coating proposed for use.
3. Include printed statement of VOC content for each product.

C. Schedule: Provide schedule of all surfaces to be coated, with prime and finish c listed, and manufacturer's recommended wet film thickness.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain primers and undercoat materials for each coating system from the same manufacturer as the finish coats.

1.6 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.

1.7 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.

1.8 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials unopened, factory sealed containers for storage and identify with labels describing contents. Deliver extra materials to the Owner at project completion.

1. Quantity: Furnish the Owner with an additional 5 percent, but not less than Liters) or 1 case, as appropriate, of each material, color, and gloss applied.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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. California Paint Co. (CAL)
   4. Sherwin-Williams Co. (S-W).
   5. Tnemec Company, Inc. (Tnemec).

2.2 COATINGS MATERIALS, GENERAL

A. Material Compatibility: Provide 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 for Exterior and Interior Paints and Coatings: Provide the manufacturer's formulation for the products specified below that are VOC compliant with the State of Maine Department of Environmental Protection Regulation, "Chapter 151: Architectural and Industrial Maintenance (AIM) Coatings" and the following chemical restrictions expressed in grams per liter:
   1. Flat Paints and Coatings: VOC content of not more than 100 g/L.
   2. Non-Flat Paints and Coatings: VOC content of not more than 150 g/L.
   3. Anticorrosive (Rust Preventative) Coatings: VOC content of not more than 400 g/L.
   4. Clear Wood Coatings:
      a. Clear Brushing Lacquers: VOC content of not more than 680 g/L.
   5. Fire Retardant Coatings:
      a. Opaque: VOC content of not more than 350 g/L.
   6. Industrial Maintenance Coatings (IMC): VOC content of not more than 340 g/L.
   7. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
   8. Quick-Dry Enamels: VOC content of not more than 250 g/L.
   9. Quick-Dry Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
   10. Specialty Primers, Sealers, and Undercoaters: VOC content of not more than 350 g/L.

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11. Stains: VOC content of not more than 250 g/L.

D. Colors: Provide color selections made by the Architect.

E. EXECUTION

2.3 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator and drywall subcontractor present, under which painting will be performed for compliance with paint application requirements.
   1. Inspect walls for dents and imperfections prior to painting. Inspect walls again after primer and first coat of paint applied, with Applicator, drywall subcontractor, and plaster subcontractor present. Drywall subcontractors shall touch-up their respective work as follows:
      a. Touch-up visible plaster and gypsum board imperfections before priming of walls.
      b. Touch-up imperfections found in field of gypsum plaster and gypsum boards and joints made visible from painting after first finish coat applied.
   2. If unacceptable conditions are encountered, prepare written report, endorsed by Applicator, listing conditions detrimental to performance of work.
   3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   4. Application of coating indicates Applicator's acceptance of surfaces and conditions within a particular area.
   5. 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.

2.4 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. 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.

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a. Scrape and clean small, dry, seasoned knots, and apply a thin coat or other recommended knot sealer before applying primer. After p holes and imperfections in finish surfaces with putty or plastic wo smooth when dried.
b. Prime, stain, or seal wood to be painted immediately on delivery. ends, faces, undersides, and back sides of wood.
c. If transparent finish is required, backprime with spar varnish.

3. 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. Clean with solvents recommended by paint manufacturer and SSPC SP2; and touch up with same primer as the shop coat.
4. 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 to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
   a. Clean field welds with nonpetroleum-based solvents complying with SSPC's standards so surface is free of oil and surface contaminants.
5. Existing Wood Surfaces: Scrape loose paint from surfaces indicated to be recoated. Sand edges of remaining paint to smooth out surface. Prior to sanding, test existing coatings for lead. If lead paint is found, notify Architect in writing for direction on how to proceed. Prime bare surfaces prior to recoating.

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.

2.5 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.

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6. Paint interior surfaces of ducts with a flat, nonspecular black paint where registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to mat surfaces.
8. Finish exterior doors on tops, bottoms, and side edges the same as exteri
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.

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.

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G. Mechanical and Electrical Work: Painting of mechanical, plumbing, fire protec electrical work is limited to items exposed in occupied spaces (outside mechani rooms).

H. Mechanical, plumbing, and fire protection, items to be painted include, but are the following:
   1. Piping, pipe hangers and supports.
   2. Ductwork, including interior of ductwork visible through air devices.
   3. Accessory items.

I. Electrical items to be painted include, but are not limited to, the following:
   1. Conduit and fittings.
   2. Panelboards.

J. 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 to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

K. 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.

L. Transparent (Clear or Stained) 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.

M. 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.

N. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

O. 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. Steel pipe railings.
   4. Metal Fabrications. See Section 05500.
   5. Factory primed louvers.
   6. Miscellaneous metal items, including galvanized steel.

P. Interior Ferrous Metal Items to Be Painted Include, but Are Not Limited To, the Following:
   1. Steel doors and frames.
   2. Handrails and guardrails.
   3. Access panels (both sides).
   4. Metal fabrications. See Section 05500.
   5. Miscellaneous metal items.

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2.6 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and o paint materials from the Project site.
   1. After completing painting, clean glass and paint-spattered surfaces. Rem paint by washing and scraping. Be careful not to scratch or damage adja surfaces.

2.7 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.

2.8 EXTERIOR PAINT SCHEDULE

A. VOC Compliance, General: Provide the manufacturers' formulations for the products specified below that comply with the VOC requirements for the State of Maine Department of Environmental Protection in paragraph 2.2.C2.02.C of this Section.

B. Wood Siding and Trim, Opaque Finish: Provide the following finish systems over smooth wood siding and other smooth, exterior wood surfaces:
   1. Flat Acrylic Finish: 2 finish coats over a primer.
      a. Primer: Exterior, alkyd or latex, 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: 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 Flat Latex House Paint No. 171; 2.4 mils DFT.
         2) ICI: 2200-XXXX Dulux Professional Exterior 100 Percent Acrylic Flat Finish; 2.6 mils DFT.
         3) S-W: SuperPaint Exterior Latex Flat A80 Series; 2.8 mils DFT.
   2. Low-Luster Acrylic Finish: 2 finish coats over a primer.
      a. Primer (New and Bare Spots of Existing): Exterior, alkyd or latex, 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 LatexAlkyd Exterior Primer No. 169176; 1.41.8 mils DFT.

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2) ICI: 2000-1200 Dulux Professional Exterior 100% A
Primer; 1.6 mils DFT.
3) S-W: A-100 Exterior Latex Wood Primer B42W8041;

b. First and Second Coats: Low-sheen (eggshell or satin), exterior, la
applied at spreading rate recommended by the manufacturer to ach
film thickness of not less than indicated for product.
1) Moore: Moorcraft Super Spec 100% Acrylic Latex Low Lustre Latex House Paint No. N185; 3.02.0 mils DFT.
2) ICI: 2402-XXXX Dulux Professional Exterior 100% Acrylic Satin Finish; 2.8 mils DFT.
3) S-W: SuperPaint Exterior Latex Satin A89-100 Series; 3.0 mils DFT.

3. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a primer.
a. Primer: Exterior, alkyd or latex, 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: 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: 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: 4206-XXXX, Interior/Exterior Waterborne Acrylic Semi-Gloss Enamel; 3.0 mils DFT.
3) S-W: SuperPaint Exterior Gloss Latex A84 Series; 3.0 mils DFT.

4. Full-Gloss, Acrylic-Enamel Finish: 2 finish coats over a primer.
a. Primer: Exterior, alkyd or latex, 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: 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: Full-gloss, waterborne, 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: Moore's IMC Acrylic Gloss Enamel M28; 4.0 mils DFT.
2) ICI: Deflex 4218-XXXX, Direct-To-Metal Exterior Waterborne Enamel2.0 mils DFT.
3) S-W: DTM Acrylic Coating Gloss (Waterborne) B66W100 Series; 5.0 mils DFT.

C. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
1. Flat/Low-Luster, Alkyd-Enamel Finish: 2 finish coats over a rust-inhibitive primer.

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a. Primer: Rust-inhibitive metal primer applied at spreading rate rec
the manufacturer to achieve a total dry film thickness of not less th
product.
1) Moore: IronClad Alkyd Low Lustre Metal & Wood Ena
mils DFT.
2) S-W: Kem Kromik Universal Metal Primer B50WZ1;

b. First and Second Coats: Flat, exterior, alkyd 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: Moore's Eggshell Finish House Paint C108; 2.8 mils DFT.
2) S-W: ProMar Alkyd Flat Exterior Finish B-38 Series; 4.0 mils DFT.

2. Low-Luster Acrylic 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: Devflex 4020-1000, DTM Flat Interior/Exterior Waterborne Primer & Finish; 2.2 DFT.
3) S-W: Kem Kromik Universal Metal Primer B50WZ1; 3.0 DFT.
4) Tnemec: Tnemec Primer, Series 10; 2.0 mils DFT.
b. First and Second Coat: Low-sheen (eggshell or satin), exterior, acrylic-latex 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 Low Lustre Latex House Paint No. 185; 2.0 mils DFT.
2) ICI: 2402-XXXX Dulux Professional Exterior 100 Percent Acrylic Satin Finish; 2.8 mils DFT.
3) S-W: A-100 Exterior Latex Satin House & Trim Paint A82 Series; 3.0 mils DFT.
4) Tnemec: Tneme-Cryl, Series 6; 4.0 mils DFT.

3. Semigloss, Acrylic-Enamel Finish: 2 IMC finish coats over a corrosion resistantrust-inhibitive primer.
a. Primer: Quick-drying, corrosion resistant, 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: IMC MP04 Acrylic Metal Primer; 2.0 mils DFT.
2) ICI: IMC 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish; 2.5 mils DFT.
3) S-W: IMC DTM Acrylic Primer/Finish/ B66W1; 2.5 mils DFT.
4) Tnemec: Tnemec Primer, Series 10; 2.0 mils DFT.
b. First and Second Coats: Semigloss, exterior, IMC 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: IMC DTM MP29 Acrylic Semigloss; 4.0 mils DFT.
2) ICI: IMC 4216-XXXXV, High Performance Waterborne Acrylic Semi-Gloss Enamel; 8.0 mils DFT4206-XXXX, Interior/Exterior Acrylic Semi-Gloss Enamel; 3.0 mils DFT.
3) S-W: IMC DTM Acrylic Coating Semi-Gloss (Waterborne) B66W200 Series; 7.05.0 mils DFT.
4) Tnemec: Tneme-Cryl SG, Series 7; 4.0 mils DFT.

4. Full-Gloss, Alkyd-Enamel Finish: 2 finish coats over a rust-inhibitive primer.

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a. Primer: Rust-inhibitive metal primer applied at spreading rate rec the manufacturer to achieve a total dry film thickness of not less th product.
   1) Moore: Moore's IMC Alkyd Metal Primer No. M06; 2.0
   2) ICI: 4160-XXXX Devguard Multi-Purpose Tank & S (2.0 mils DFT).
   3) S-W: Kem Kromik Universal Metal Primer B50WZ1; 3.0 mils DFT.
b. First and Second Coats: Full-gloss, exterior, alkyd 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: Moore's IMC Urethane Alkyd Enamel M22; 4.0 mils DFT.
   2) ICI: 4308-XXXX Devguard Alkyd Industrial Gloss Enamel; 4.0 mils DFT.
   3) S-W: Industrial Enamel B-54 Series; 4.0 mils DFT.

5. Full-Gloss, 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: DTM Acrylic Primer/Finish/B66W1; 2.5 mils DFT.
   b. First and Second Coats: Full-gloss, waterborne, acrylic enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated.
      1) Moore: Moore's IMC DTM Acrylic Gloss Enamel M28; 4.0 mils DFT.
      2) ICI: 4218-XXXX, Deflex Direct-To-Metal Exterior Waterborne Enamel; 3.0 mils DFT.
      3) S-W: DTM Acrylic Coating Gloss (Waterborne) B66W100 Series; 5.0 mils DFT.

2.9 INTERIOR COATINGS

A. VOC Compliance, General: Provide the manufacturers' formulations for the products specified below that comply with the VOC requirements in paragraph 2.2.C of this Section.

B. Gypsum Board & Plaster: Provide the following finish systems over interior gypsum board surfaces:
   1. Flat Acrylic Finish, GPDW 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: Ben Premium Interior Latex Primer No. W624; 1.1 mils DFT.
         2) ICI: 1000-1200, Prep & Prime Hi-Hide Wall Interior Water-Based Primer Sealer; 1.9 mils DFT.
         3) S-W: ProGreen 200 Low VOC Interior Latex Primer B28W600 Series; 1.5 mils DFT.
      b. First and Second Coats: Flat, acrylic-latex-based, interior 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: Ben Acrylic Latex Flat No. W625; 2.4 mils DFT.

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2) ICI: 1210-XXXX, Ultrahide Interior Flat Latex Wall 2.8 mils DFT.
3) S-W: ProGreen 200 Low VOC Interior Latex Primer E 1.5 mils DFT.

2. Low-Luster (Eggshell), Acrylic-Enamel Finish, Walls: 2 finish coats ove
   a. Primer: Latex-based, interior primer applied at spreading rate recc the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: Ben Premium Interior Latex Primer No. W624; 1.1 mils DFT.
      2) ICI: 1000-1200, Prep & Prime Hi-Hide Wall Interior Water-Based Primer Sealer; 1.9 mils DFT.
      3) S-W: ProGreen 200 Low VOC Interior Latex Primer B28W600 Series; 1.5 mils DFT.
   b. First and Second Coats: Low-luster (eggshell or satin), 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: Ben Interior Acrylic Latex Eggshell No. W626; 2.6 mils DFT.
      2) ICI: 1210-XXXXV, Ultrahide Latex Flat Interior Wall Paint; 2.8 mils DFT.
      3) S-W: ProGreen 200 Low VOC Interior Latex Eg-Shel B20-600 Series; 3.4 mils DFT.

C. Natural-Finish Woodwork: Provide the following natural finishes over new, interior woodwork:
   1. Waterborne, Satin-Polyurethane 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: Benwood Stays Clear Acrylic Polyurethane No. 423.
         2) S-W: Minwax Polycrylic.

D. Woodwork, Opaque Finish: Provide the following paint finish systems over new, interior wood surfaces:
   1. Semigloss, Acrylic-Enamel Finish (Opaque Trim): 2 finish coats over a wood undercoater.
      a. Primer: Stain-blocking, acrylic-latex-based, interior wood undercoater, 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: Fresh Start All Purpose 100% Acrylic Primer No. 023; 1.1 mils DFT.
         2) ICI: 3210 Prep & Prime Gripper Multi-Purpose Acrylic Latex Primer; 1.5 mils DFT.
         3) S-W: ProGreen 200 Low VOC Interior Latex Primer B28W600 Series; 1.5 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: Ben Interior Acrylic Latex Semi-Glass No. W627; 2.1 mils DFT.
         2) ICI: 1416-XXXXN Ultrahide Semi-Gloss Interior Wall & Trim Enamel; 3.0 mils DFT.

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3) S-W: ProGreen 200 Low VOC Interior Latex Semi-Gl B31-600 Series; 3.2 mils DFT.

E. Ferrous Metal: Provide the following finish systems over ferrous metal:
1. Semigloss, Acrylic-Enamel Finish: 2 IMC finish coats over a primer.
   a. Primer: Quick-drying, corrosion resistant, acrylic primer, as recon 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: IMC Super Spec HP Acrylic Metal Primer P04; 2.0 mils DFT.
      2) ICI: IMC 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish; 2.2 mils DFT.
      3) S-W: IMC DTM Acrylic Primer/Finish, B66W1; 3.0 mils DFT.
   b. First and Second Coats: IMC 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: IMC DTM Acrylic Semi-Gloss P29; 5.0 mils DFT.
      2) ICI: IMC 4216-XXXXV High Performance Waterborne Acrylic Semi-Gloss Enamel; 8.0 mils DFT .
      3) S-W: IMC DTM Acrylic Coating Semi-Gloss (Waterborne) B66W200 Series; 7.0 mils DFT.

F. Zinc-Coated Metal: Provide the following finish systems over zinc-coated metal:
1. Semigloss, Acrylic-Enamel Finish: 2 IMC 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: IMC Super Spec HP Acrylic Metal Primer M04; 2.0 mils DFT.
      2) ICI: IMC 4020-XXXX DTM Flat Interior/Exterior Waterborne Primer & Finish; 2.2 mils DFT.
      3) S-W: IMC DTM Acrylic Primer/Finish, B66W1; 3.0 mils DFT.
   b. First and Second Coats: IMC 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: IMC DTM Acrylic Semigloss P29; 5.0 mils DFT.
      2) ICI: IMC 4216-XXXXV High Performance Waterborne Acrylic Semi-Gloss Enamel 8.0 mils DFT.
      3) S-W: IMC DTM Acrylic Coating Semi-Gloss (Waterborne) B66W200 Series; 7.0 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: Fresh Start All-Pupose 100% Acrylic Primer No. 023; 1.1 mils DFT.
      2) SW: ProGreen 200 Low VOC Interior Latex Primer B28W600 Series; 1.5 mils DFT

b. First and Second Coats: Intumescent-type, fire-retardant paint app
rate recommended by manufacturer to achieve a total dry film thic
than 4 mils; white color for telecommunication and black for elect

1) Moore: M59 220 Latex Fire-Retardant Coating.
2) FlameControl: 20-20A Flat Latex Intumescent Coating.

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SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard 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: 15years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 PUBLIC-USE WASHROOM ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products following

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
6. Tubular Specialties Manufacturing, Inc.

C. Grab Bar

1. Basis-of-Design Product: <Bobrick 5800 Series >.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.

a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area. Oiled Bronze color.

4. Outside Diameter: 1-1/2 inches (38 mm).
5. Configuration and Length: As indicated on Drawings.

PART 3 - EXECUTION

3.1 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.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

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SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

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. The entire building shall be protected by a wet pipe fire suppression system.

B. The fire protection system shall be installed in accordance with the 2010 edition of NFPA.

C. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Sleeves.
3. Escutcheons.
4. Equipment installation requirements common to equipment sections.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

D. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
1. Mechanical sleeve seals.
2. Escutcheons.

B. Welding certificates.

1.5 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

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1. Submit electronic submittals by either of the following methods:
   a. Via email as PDF electronic file to **submittals@harriman.com** .
      1) Architect will return annotated file. Annotate and retain or an electronic Project record document file.
   b. Post electronic submittals as PDF electronic files directly to Arc specifically established for Project.
      1) Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

1.6 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes 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.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

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 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. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

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2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting mate methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Available Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
   2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   3. Pressure Plates: Carbon steel . Include two for each sealing element.
   4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. PVC Pipe: ASTM D 1785, Schedule 40.

D. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

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2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with fit around pipe, tube, and insulation of insulated piping and an OD that co opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated or white painted in finished spaces.

D. One-Piece, Floor-Plate Type: Cast-iron floor plate.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.

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c. Bare Piping in Unfinished Service Spaces: One-piece, cast-polished chrome-plated finish.
d. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
e. Bare Piping at Floor Penetrations in Equipment Rooms: One-p type.

K. Sleeves are not required for core-drilled holes.

L. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4 inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

N. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1 inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Joint Sealants" for materials.

P. Verify final equipment locations for roughing-in.

Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.

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B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe an assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASM threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

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SECTION 211313 - WET-PIPE SPRINKLER 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. Section Includes:
1. Pipes, fittings, and specialties.
2. Fire-protection zone riser.
3. Sprinklers.
4. Exterior service piping to the service shut-off valve in the sidewalk.
5. Hydrant Flow Test.
6. Fire Department Connection.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

1.4 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat destroys frangible (glass bulb) device. Hose connections are included if indicated.

B. The sprinkler system shall be mounted as high as possible in the protected spaces.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Sprinkler system design shall be approved by authorities having jurisdiction.
1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventer.

2. Sprinkler Occupancy Hazard Classifications:
   a. Mechanical/Electrical Spaces: Ordinary Hazard, Group 2.
   b. Public Areas: Light Hazard.
3. Minimum Density for Automatic-Sprinkler Piping Design:

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a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (4.1 mm sq. m.)
b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. over 139-sq. m) area.
c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. over 139-sq. m) area.

4. Maximum Protection Area per Sprinkler:
   a. Public Areas: 225 sq. ft. (20.9 sq. m.)
   b. Storage Areas: 130 sq. ft. (12.1 sq. m.)
   c. Mechanical/Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m.)
   d. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
   a. Light-Hazard Occupancies: 100 gpm (6.3 L/s) for 30 minutes

1.6 SUBMITTALS

A. Product Data: For each type of product indicated

B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Fire-hydrant flow test report.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

F. Field quality-control reports.

G. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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C. Electrical Components, Devices, and Accessories: Listed and labeled as defi by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, install shall comply with the following:
   1. NFPA 13, "Installation of Sprinkler Systems."

1.8 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
   1. Notify Owner no fewer than two days in advance of proposed interruption of sprinkler service.
   2. Do not proceed with interruption of sprinkler service without Owner's written permission.

1.9 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M, Pipe ends may be factory or field formed to match joining method.

B. Thinwall Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

C. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end.

D. Cast-Iron Flanges: ASME 16.1, Class 125.

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E. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Manufacturers: Subject to compliance with requirements, availabl offering products that may be incorporated into the Work include, but a the following:
      a. Victaulic Company.
   2. Pressure Rating: 175 psig (1200 kPa minimum).
   3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic and asbestos free.
   1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:
   1. Valves shall be UL listed or FM approved.
   2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).

B. Ball Valves:
   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:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:
      a. Victaulic Company.
   3. Standard: UL 1091 except with ball instead of disc.
   4. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
   5. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
   6. Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.

C. Check Valves:
   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:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:
      a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
      b. Anvil International, Inc.
      c. Crane Co.; Crane Valve Group; Crane Valves.
      d. Crane Co.; Crane Valve Group; Jenkins Valves.
      e. Crane Co.; Crane Valve Group; Stockham Division.
      f. Globe Fire Sprinkler Corporation.
      g. Kennedy Valve; a division of McWane, Inc.
      h. Metraflex, Inc.

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i. Milwaukee Valve Company.
j. Mueller Co.; Water Products Division.
k. NIBCO INC.
l. Potter Roemer.
m. Reliable Automatic Sprinkler Co., Inc.
n. Tyco Fire & Building Products LP.
o. United Brass Works, Inc.
p. Victaulic Company.
q. Viking Corporation.
r. Watts Water Technologies, Inc.

3. Standard: UL 312.
4. Pressure Rating: 250 psig (1725 kPa) minimum 300 psig (2070 kPa).
5. Type: Swing check.
6. Body Material: Cast iron.
7. End Connections: Flanged or grooved.

D. Iron OS&Y Gate Valves:
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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:
a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. Mueller Co.; Water Products Division.
h. NIBCO INC.
i. Tyco Fire & Building Products LP.
j. United Brass Works, Inc.
k. Watts Water Technologies, Inc.
3. Standard: UL 262.
4. Pressure Rating: 250 psig (1725 kPa) minimum
5. Body Material: Cast or ductile iron.
6. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:
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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:
a. Anvil International, Inc.
b. Global Safety Products, Inc.
c. Kennedy Valve; a division of McWane, Inc.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Tyco Fire & Building Products LP.
g. Victaulic Company.

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3. Standard: UL 1091.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Valves NPS 2 (DN 50) and Smaller:
   a. Valve Type: Ball or butterfly.
   b. Body Material: Bronze.
   c. End Connections: Threaded.
6. Valves NPS 2-1/2 (DN 65) and Larger:
   a. Valve Type: Butterfly.
   b. Body Material: Cast or ductile iron.
   c. End Connections: Flanged, grooved, or wafer.
7. Valve Operation: Integral indicating device.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:
   1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   2. Pressure Rating: 175 psig (1200 kPa) minimum.

B. Angle Valves:
   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. Fire Protection Products, Inc.
      b. United Brass Works, Inc.

C. Ball Valves:
   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. Anvil International, Inc.
      b. Conbraco Industries, Inc.; Apollo Valves.
      c. Fire Protection Products, Inc.
      d. Kennedy Valve; a division of McWane, Inc.
      e. Kitz Corporation.
      f. Milwaukee Valve Company.
      g. NIBCO INC.
      h. Tyco Fire & Building Products LP.
      i. Victaulic Company.
      j. Watts Water Technologies, Inc.

2.6 SPECIALTY VALVES

A. General Requirements:
   1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   2. Body Material: Cast or ductile iron.
   3. Size: Same as connected piping.
   4. End Connections: Flanged or grooved.

B. Riser Zone Valves:

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1. Manufacturers: Subject to compliance with requirements, availabl offering products that may be incorporated into the Work include, but a the following:
2. Basis-of-Design Product: Subject to compliance with requirements, name or designation or comparable product by one of the following:
   a. Globe Fire Sprinkler Corporation.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
3. Standard: UL 193.
4. Design: For horizontal or vertical installation.
5. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages and fill-line attachment with strainer.
6. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
7. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:
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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:
   a. AFAC Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
3. Standard: UL 1726.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Type: Automatic draining, ball check.
6. Size: NPS 3/4 (DN 20).
7. End Connections: Threaded. F

2.7 FIRE-DEPARTMENT CONNECTION

A. Exposed-Type, Fire-Department Connection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AFAC Inc.
   b. Elkhart Brass Mfg. Company, Inc.
   c. Fire-End & Croker Corporation.
   d. Fire Protection Products, Inc.
   e. GMR International Equipment Corporation.
   f. Guardian Fire Equipment, Inc.
   g. Tyco Fire & Building Products LP.
   h. Wilson & Cousins Inc.
2. Standard: UL 405.
3. Type: Storz, Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Body Material: Corrosion-resistant metal.

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6. Inlets: Brass with threads according to NFPA 1963 and matching local sizes and threads. Include extension pipe nipples, brass lugged swivel check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: One.
11. Escutcheon Plate Marking: Similar to ″AUTO SPKR."
12. Finish: Aluminum.
13. Outlet Size: NPS 4 (DN 100).
14. Standard: UL 1474.
15. Pressure Rating: 175 psig (1200 kPa) minimum.

2.8 SPRINKLERS

A. 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:
1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products LP.
3. Victaulic Company.
4. Viking Corporation.

B. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.

C. Automatic Sprinklers with Heat-Responsive Element:
1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Residential Applications: UL 1626.
4. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:
1. Finished Ceilings: Concealed white plate.
2. Unfinished Spaces: Bronze upright or pendant.
3. Finished spaces without ceilings: Bronze exposed upright or pendant type.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed sprinklers are specified with sprinklers.
1. Ceiling Mounting: White painted steel, two piece, concealed with vertical adjustment.
2. 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. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.
3. Standard: UL 199.

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2.9 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicators:
1. Manufacturers: Subject to compliance with requirements, availabl offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Potter Electric Signal Company.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig (1725 kPa).
7. Design Installation: Horizontal or vertical.

C. Valve Supervisory Switches:
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. Potter Electric Signal Company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.10 PRESSURE GAGES

A. 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:
1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.

D. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa) minimum.

E. Water System Piping Gage: Include "WATER″ label on dial face.

2.11 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

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B. One-Piece, Stamped Steel or Plastic Split Escutcheons: Polished chrome-plated finish.

2.12 SLEEVES

A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalen pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. PVC sleeves in first two paragraphs below may be prohibited by fire authorities having jurisdiction.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
   1. Underdeck Clamp: Clamping ring with set-screws.

2.13 SLEEVE SEALS

A. 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:
   1. Advance Products & Systems, Inc.
   2. Calpico, Inc.
   3. Metraflex, Inc.
   4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Stainless steel.
   3. Connecting Bolts and Nuts: steel of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to the existing water-service entrance to the building. Comply with requirements for exterior piping in Division 21 Section.

B. Install a shutoff valve, double check valve backflow preventer, pressure gage, drain, and other accessories indicated at the connection to the existing water-service riser and piping. Comply with requirements for backflow preventers.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

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3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams location and arrangement of piping. Install piping as indicated, as far as practic
   1. Deviations from approved working plans for piping require writter authorities having jurisdiction. File written approval with Architect from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install alarm devices in piping systems.

J. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

K. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

L. Fill sprinkler system piping with water.

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

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E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, ar assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness s service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
   1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
   2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in the center of acoustical ceiling panels.

B. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.7 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:
   1. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated or white painted finish.

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2. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, polished chrome-plated or white painted finish.
3. Bare Piping in Unfinished Service Spaces: One piece, cast brass with p plated finish.
4. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor

3.8 SLEEVE INSTALLATION

A. General Requirements: Sleeves are not required for sprinkler piping.

B. For interior wall penetrations, seal annular space between wall and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

C. For exterior wall penetrations above grade, seal annular space between wall and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Through Pentetration Firestop Systems."

3.9 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.10 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

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3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Syste Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire-department equ

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.13 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain the system.

3.14 PIPING SCHEDULE

A. Standard-pressure, wet-pipe sprinkler system, NPS 2 (DN 50) and smaller, shall be one of the following:
1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight black-steel pipe with cutgrooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

B. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) shall be one of the following:

1. Standard-weight, black-steel pipe with cutgrooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Schedule 10black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

C. Standard-pressure, wet-pipe sprinkler system, NPS 5 (DN 125) and larger, shall be one of the following:
1. Standard-weight black-steel pipe with cutgrooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.15 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Bronze finish upright or pendant sprinklers
2. Hard ceilings (gypsum) and soffits: Concealed plate type sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover pla
2. Exposed upright pendant Sprinklers: Rough bronze.

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SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

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. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Equipment installation requirements common to equipment sections.
8. Painting and finishing.
9. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

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1.4 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Mechanical sleeve seals.
   3. Escutcheons.

1.5 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
   1. Submit electronic submittals by either of the following methods:
      a. Via email as PDF electronic file to **submittals@harriman.com** .
         1) Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
      b. Post electronic submittals as PDF electronic files directly to Architect's FTP site specifically established for Project.
         1) Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes 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.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.8 PERMITS

A. Obtain Plumbing Permit and pay fee.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

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2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting mate methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

C. Solvent Cements for Joining Plastic Piping:
1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
3. ABS Piping: ASTM D 2235.

D. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
1. Manufacturers:
a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.
f. Viking Johnson.
2. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
3. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
1. Manufacturers:
a. Eslon Thermoplastics.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
1. Manufacturers:
a. Thompson Plastics, Inc.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
1. Manufacturers:
a. NIBCO INC.

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b. NIBCO, Inc.; Chemtrol Div.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping with elastomeric sleeve, ends same size as piping to be joined, and corrosion band on each end.

1. Manufacturers:
   a. Cascade Waterworks Mfg. Co.
   b. Fernco, Inc.
   c. Mission Rubber Company.
   d. Plastic Oddities, Inc.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. PVC Pipe: ASTM D 1785, Schedule 40.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

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F. Install piping to within 18" of the ceiling to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Insulated Piping: One-piece, stamped-steel type with spring clips.
      c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.

M. Sleeves are not required for core-drilled holes.

N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
      b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
         1) Seal space outside of sleeve fittings with grout.
   4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Joint Sealants" for materials.

P. Verify final equipment locations for roughing-in.

Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

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3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Divi specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. PVC Nonpressure Piping: Join according to ASTM D 2855.
   3. ABS Non-Pressure Piping: ASTM D 2235.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

B. Field Welding: Comply with AWS D1.1.

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SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

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. Thermometers.
2. Gages.

B. Related Sections:
1. Division 22 Section "Domestic Water Piping".

1.3 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED DIAL THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide Trerice H.O. Co. or comparable product by one of the following:
1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Palmer - Wahl Instruments Inc.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

C. Description: Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.

D. Case: Dry type, stainless steel with 5-inch (127-mm) diameter.

E. Element: Bimetal coil.

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F. Dial: Satin-faced, nonreflective aluminum with permanently etched scale mark

G. Pointer: Red or other dark-color metal.

H. Window: Glass .

I. Ring: Metal, Brass or Stainless steel.

J. Connector: Adjustable angle type.

K. Stem: Metal, for thermowell installation and of length to suit installation.

L. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.2 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide Trerice H.O. Co. product indicated on Drawings or comparable product by one of the following:
1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Palmer - Wahl Instruments Inc.
4. Trerice, H. O. Co.
5. Weiss Instruments, Inc.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

C. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
1. Case: Dry type, drawn steel or cast aluminum , 4-1/2-inch (114-mm) diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4 (DN 8), bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass or plastic .
8. Ring: Metal, Brass or Stainless steel.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure (100 kPa of vacuum to 103 kPa of pressure).
11. Range for Fluids under Pressure: Two times operating pressure.

D. Pressure-Gage Fittings:
1. Valves: NPS 1/4 (DN 8) brass or stainless-steel needle type.
2. Snubbers: ASME B40.5, NPS 1/4 (DN 8) brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

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PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install direct-mounting, vapor-actuated dial thermometers in the outlet of eac water storage tank.

B. Install dry -case-type, vapor -actuated dial thermometers at suction and discharge of each pump.

C. Provide the following temperature ranges for thermometers:
   1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions (Minus 1 to plus 82 deg C, with 1-degree scale divisions).
   2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions (Minus 18 to plus 38 deg C, with 1-degree scale divisions).

3.2 GAGE APPLICATIONS

A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.

B. Install dry-case-type pressure gages at suction and discharge of each pump.

C. Pressure scale: 0 to 100 psi at 2 psi scale divisions.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.

C. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.

D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

E. Install remote-mounting pressure gages on panel.

F. Install needle-valve and snubber fitting in piping for each pressure gage.

G. Install permanent indicators on walls or brackets in accessible and readable positions.

H. Install connection fittings for attachment to portable indicators in accessible locations.

I. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.

J. Adjust faces of thermometers and gages to proper angle for best visibility from the floor.

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SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

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. Bronze ball valves.
2. Bronze swing check valves.

B. Related Sections:
1. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. RS: Rising stem.

E. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.

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2. Protect threads, flange faces, grooves, and weld ends.
3. Set ball and plug valves open to minimize exposure of functional surface

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

E. Valve-End Connections:
1. Solder Joint: With sockets according to ASME B16.18.
2. Threaded: With threads according to ASME B1.20.1.

F. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
1. Manufacturers: Subject to compliance with requirements :
a. Conbraco Industries, Inc.; Apollo Valves.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

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2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:
   1. Manufacturers: Subject to compliance with requirements, :
      a. Hammond Valve.
      b. Milwaukee Valve Company.
      c. NIBCO INC.
      d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      a. Standard: MSS SP-80, Type 3.
      b. CWP Rating: 200 psig (1380 kPa).
      c. Body Design: Horizontal flow.
      d. Body Material: ASTM B 62, bronze.
      e. Ends: Threaded.
      f. Disc: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.

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3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and pu
before final adjusting and balancing. Replace valves if persistent leaking occur

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
1. Shutoff Service: Ball valves.
2. Throttling Service: Ball valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.

END OF SECTION 220523

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQ

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 hangers and supports for plumbing system piping and equipment:
   1. Steel pipe hangers and supports.

B. Trapeze pipe hangers.

1.3 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.

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 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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Available Manufacturers:
   1. B-Line Systems, Inc.; a division of Cooper Industries.
   2. Carpenter & Paterson, Inc.
   3. ERICO/Michigan Hanger Co.
   4. Grinnell Corp.

C. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

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2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support asse structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Available Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Power-Strut Div.; Tyco International, Ltd.
3. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.

G. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).

H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.

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I. Saddles and Shields: Unless otherwise indicated and except as specified i Sections, install the following types:
   1. Protection Shields (MSS Type 40): Of length recommended in writing to prevent crushing insulation.

J. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

K. Fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

E. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

F. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
   3. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
   4. Insert Material: Length at least as long as protective shield.
   5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

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3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachmen indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inche

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SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

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B. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mecha
      1/16 inch (1.6 mm) thick, and having predrilled holes for attachment harc
   2. Letter Color: White.
   3. Background Color: Black.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
   6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. Fasteners: Stainless-steel self-tapping screws.
   8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm).

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
   1. Tag Material: Brass, 0.032-inch (0.8-mm minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.

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PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond devices, including dirt, oil, grease, release agents, and incompatible prim encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
   7. Pipes shall not be labeled where they pass over public restaurant spaces.

B. Pipe Label Color Schedule:
   1. Domestic Cold Water Piping:
      a. Background Color: Green.
      b. Letter Color: White.
   2. Domestic Hot Water, and Hot Water Return Piping:
      a. Background Color: Yellow.
      b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
   1. Valve-Tag Size and Shape:
      a. Cold Water: 1-1/2 inches (38 mm), round.
      b. Hot Water: 1-1/2 inches (38 mm), round.
   2. Valve-Tag Color:

a. Cold Water: Natural.
b. Hot Water: Natural.

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SECTION 220700 - PLUMBING INSULATION

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. Insulation Materials:
   a. Flexible elastomeric.
   b. Mineral fiber.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Field-applied jackets.
11. Tapes.
12. Securements.
13. Corner angles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:
1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

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D. Material Test Reports: From a qualified testing agency acceptable to au jurisdiction indicating, interpreting, and certifying test results for compliar materials, sealers, attachments, cements, and jackets, with requirements inc dates of tests and test methods employed.

E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

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PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating m applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Micro-Lok.
      b. Knauf Insulation; 1000 Pipe Insulation.
      c. Owens Corning; Fiberglas Pipe Insulation.
   2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
   3. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
      a. Products: Subject to compliance with requirements, provide the following :
         1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

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2.3 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with a
complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the fo
a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 08
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. Venture Tape; 1506 CW NS.
2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

2.4 CORNER ANGLES

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

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B. Mix insulating cements with clean potable water; if insulating cements are to b stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, ar free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

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3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Instal longitudinal seams at bottom of pipe. Clean and dry surface to receive Staple laps with outward clinching staples along edge at 2 inches (50 mm
   a. For below ambient services, apply vapor-barrier mastic over staple
4. Cover joints and seams with tape as recommended by insulation materia maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
   4. Manholes.
   5. Handholes.
   6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

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3. Extend jacket of outdoor insulation outside wall flashing and overlap least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Division 07 Section "Joint Sealants" and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Joint Sealants".

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

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7. Cover segmented insulated surfaces with a layer of finishing cement mastic. Install vapor-barrier mastic for below ambient services and a br above ambient services. Reinforce the mastic with fabric-reinforcing m mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for fle and polyolefin, install fitted PVC cover over elbows, tees, strainers, val unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

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4. Secure insulation to flanges and seal seams with manufacturer's recomr to eliminate openings in insulation that allow passage of air to surface be

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recomme eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Place PVC cover fitting over the elbow and secure with bands.
2. Install sections of pipe insulation, to a thickness equal to adjoining pipe insulation.

C. Provide Black PVC jacket on all exposed piping running below floor framing in the restaurant public spaces and install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of

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inspection shall be limited to one location(s) for each type of equipme "Equipment Insulation Schedule" Article. For large equipment, remov adequate to determine compliance.

2. Inspect pipe, fittings, strainers, and valves, randomly selected by Archit field-applied jacket and insulation in layers in reverse order of their ins of inspection shall be limited to three locations of straight pipe, th threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:
1. NPS ½ and NPS ¾ : Insulation shall be one of the following:
   a. Flexible Elastomeric: 1/2 inch (13 mm) thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.
2. NPS 1 (DN 25) and NPS 1-1/4 (DN 32): Insulation shall be one of the following:
   a. Flexible Elastomeric: 1/2 inch (13 mm) thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.
3. NPS 1-1/2 (DN 40) and Larger: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1/2 inch (13 mm) thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

B. Domestic Hot Water:
1. NPS 1 (DN 25) and Smaller: Insulation shall be one of the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
2. NPS 1-1/4 (DN 32) : Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch (38 mm) thick.
3. NPS 1-1/2 (DN 40) and NPS 2 (DN 50) : Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch (38 mm) thick.

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SECTION 221116 - DOMESTIC WATER PIPING

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. Domestic water pipes, tubes, fittings, and specialties inside the building.
2. Escutcheons.
3. Sleeves and sleeve seals.
4. PEX tubing shall be utilized for all domestic hot and cold water piping within the building up to and including 1-1/2" size.
5. Copper tubing shall be utilized for domestic cold water piping 2" in size.
6. Copper tubing shall be utilized for hot and cold piping is exposed below sinks and equipment.
7. Copper tubing shall be utilized at connections to the water heater and thermostatic mixing valve and where PEX is not recommended by the manufacturer.

1.3 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

1.4 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
1. Notify Owner no fewer than two days in advance of proposed interruption of water service.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

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3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock bod socket, metal-to-metal seating surfaces, and solder-joint or threaded ends
   a. Manufacturers: Subject to compliance with requirements, provide of the following:
      1) Elkhart Products Corporation; Industrial Division.
      2) NIBCO INC.
   b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
   c. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.

C. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.1 PEX TUBE AND FITTINGS

A. Basis of Design: Uponor
   1. Contact: 5925 148th Street West, Apple Valley, MN 55124; Toll free (800) 321-4739, (952) 891-2000; Fax: (952) 891-2008; website: www.uponor-usa.com

2.03 Materials

A. Tubing
   1. Material: Crosslinked polyethylene (PEX) manufactured by PEX-a or Engel method
   2. Type: Wirsbo color coded AQUAPEX in straight lengths of tube. Hot water piping shall be red, cold water shall be blue.
   3. Coiled tubing is permitted only within stud partitions and shall be properly secured.
   4. Material Standard: Manufactured in accordance with ASTM F876 and ASTM F877 and tested for compliance by an independent third party agency
   5. Standard grade hydrostatic design and pressure ratings from PPI
   6. Fire-rated assembly listings in accordance with ANSI/UL 263
      a. UL Design No. L557 — 1-hour wood frame floor/ceiling assemblies
      b. UL Design No. K913 — 2-hour concrete floor/ceiling assemblies
      c. UL Design No. U372 — 1-hour wood stud/gypsum wallboard wall assemblies
      d. UL Design No. V444 — 1-hour steel stud/gypsum wallboard wall assemblies
   7. Minimum Bend Radius (cold bending): No less than six times the outside diameter. Use a bend support as supplied by the PEX tubing manufacturer for tubing with a bend radius less than stated.
   8. Nominal Inside Diameter: Provide tubing with nominal inside diameter, in accordance with ASTM F876 as indicated.

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a. ⅜ inch

b. ½ inch

c. ¾ inch

d. 1 inch

e. 1¼ inch

f. 1½ inch

B. Fittings

1. Material: Fitting assembly is manufactured from material listed in paragraph 5.1 of ASTM F1960.
2. Material Standard: Comply with ASTM F1960.
3. Type: PEX-a cold expansion fitting.
    a. Assembly consists of the appropriate ProPEX insert with a corresponding ProPEX Ring.

C. Accessories

1. Angle stops and straight stops that are compatible with PEX tubing are supplied by the PEX tubing manufacturer.
2. Bend supports designed for maintaining tight radius bends are supplied by the PEX tubing manufacturer.
3. ProPEX expander tool to install the ASTM F1960 compatible fittings are supplied by the PEX tubing manufacturer.
4. The tubing manufacturer provides clips and/or PEX rails for supporting tubing runs.
5. All horizontal tubing hangers and riser clamps are epoxy-coated material.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance.

C. Install domestic water piping level and plumb.

D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

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E. Install piping indicated to be exposed and piping in equipment rooms and serv angles or parallel to building walls. Diagonal runs are prohibited unless speci otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling pa coordinate with other services occupying that space.

G. Install piping adjacent to equipment and specialties to allow service and maintenance.

H. Install piping to permit valve servicing.

I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

3.2 PEX TUBING INSTALLATION INSTRUCTIONS

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions, design drawings and the Uponor Professional Plumbing Installation Guide.

B. Installation
   1. Wirsbo AQUAPEX Tubing
      a. Install Wirsbo AQUAPEX tubing in accordance with the tubing manufacturer's recommendations and as indicated in the installation handbook.
      b. Do not install PEX tubing within 6 inches of gas appliance vents or within 12 inches of any recessed light fixtures.
      c. Do not solder within 18 inches of PEX tubing in the same waterline. Make sweat connections prior to making PEX connections.
      d. Do not expose PEX tubing to direct sunlight for more than 30 days.
      e. Ensure no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the tubing manufacturer.
      f. Use grommets or sleeves at the penetration for PEX tubing passing through metal studs.
      g. Protect PEX tubing with sleeves where abrasion may occur.
      h. Use strike protectors where PEX tubing penetrates a stud or joist and has the potential for being struck with a screw or nail.
      i. Use tubing manufacturer-supplied bend supports where bends are less than six times the outside tubing diameter.
      j. Minimum horizontal supports are installed not less than 32 inches between hangers in accordance with model plumbing codes and the installation handbook.
      k. PEX riser installations require epoxy-coated riser clamps installed at the base of the ceiling per floor.
      l. A mid-story support is required for riser applications.
      m. Pressurize Wirsbo AQUAPEX tubing with air in accordance with applicable codes or in the absence of applicable codes to a pressure of 25 psi (173 kPa) above normal working pressure of the system.

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n. Comply with safety precautions when pressure testing, in compressed air, where applicable. Do not use water to pressuri ambient air temperature has the possibility of dropping below 32°I

C. Through-penetration Firestop
1. Ensure compliance of one- and two-hour rated through penetratio accordance with ASTM E814.
2. A list of firestop manufacturers that list PEX tubing with their firestop systems is available from the PEX tubing manufacturer.
3. Related Products Installation: Refer to other sections listed in Related Sections paragraph herein for related products installation.

D. Cleaning
1. Remove temporary coverings and protection of adjacent work areas.
2. Repair or replace damaged installed products.
3. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.
4. Remove construction debris from project site and legally dispose of debris.

E. Protection
1. Protect installed work from damage due to subsequent construction activity on the site.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

3.4 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 (DN 50) and smaller.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

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3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Hangers and Supports for and Equipment" for pipe hanger and support products and installation.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to existing water piping within the building.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Plumbing Fixtures and equipment: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.

3.7 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:
   1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
   2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
   3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.

C. Escutcheons for Existing Piping:
   1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
   2. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:
   1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

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a. Roughing-in Inspection: Arrange for inspection of piping befo closing-in after roughing-in and before setting fixtures.
b. Final Inspection: Arrange final inspection for authorities havin observe tests specified below and to ensure compliance with requi

3. Reinspection: If authorities having jurisdiction find that piping will inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:
1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

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2. Use purging and disinfecting procedures prescribed by authorities havir methods are not prescribed, use procedures described in either A AWWA C652 or follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water d outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Domestic water piping, NPS 2 (DN 50), and smaller as indicated in the section summary of this section shall be the following:
   1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); cast-copper solder-joint fittings; and soldered joints.
   2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) ; copper push-on-joint fittings; and push-on joints.

B. Domestic water piping, 1-1/2" and smaller as indicated in the section summary of this section shall be the following: PEX.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use ball valves for piping NPS 2 (DN 50) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
   2. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
   3. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

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SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

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 domestic water piping specialties:
   1. Vacuum breakers.
   2. Temperature mixing valves.
   3. Drain valves.
   4. Water hammer arresters.

B. Related Sections include the following:
   1. Division 22 Section "Domestic Water Piping".

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. 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.

B. NSF Compliance:
   1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
   2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

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PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide produ following:
   a. Ames Co.
   b. FEBCO; SPX Valves & Controls.
   c. Watts Industries, Inc.; Water Products Div.
   d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

2.1 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. FEBCO; SPX Valves & Controls.
   b. Watts Industries, Inc.; Water Products Div.
   c. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: NPS 3/4 (DN 20).
5. Body: Bronze.
6. End Connections: Solder joint.
7. Finish: Rough bronze.

B. Reduced-Pressure-Principle Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Watts. Subject to compliance with requirements, provide a comparable product by one of the following:
   a. Ames Co.
   b. FEBCO; SPX Valves & Controls.
   c. Watts Industries, Inc.; Water Products Div.
   d. Zurn Plumbing Products Group; Wilkins Div.
3. Water Entrance: Model 909QT, 1-1/2” threaded with 1-1/2” quarter turn ball valves. The Reduced Pressure Zone Assembly: The assembly shall include two tightly closing shutoff valves before and after the assembly, test cocks and a protective strainer upstream of the No. 1 shutoff valve.
4. Boiler Supply: Model 909M1QT, 1” threaded, with quarter turn ball valves.
5. Standard: ASSE 1013.
6. Operation: Continuous-pressure applications.
7. Configuration: Designed for horizontal, straight through flow.

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2.2 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
1. Manufacturers: Subject to compliance with requirements, provide produ following:
   a. Watts Industries, Inc.; Water Products Div.
   b. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
4. Size: 1/2".
5. Design Flow Rate: 5 gpm (L/s).
6. Design Inlet Pressure: 60 psig (kPa).
7. Design Outlet Pressure Setting: 20 psig (kPa).
8. Body: Bronze for NPS 2 (DN 50) and.
9. Valves for Kitchen Dishwasher Water Supplies: Include integral bypass.
10. End Connections: Threaded.

2.3 THERMOSTATIC MIXING VALVE

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Leonard Valve Company.
   b. Powers.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Leonard model LV-981-LF-BDT, Lead Free Thermostatic Mixing Valve with ball valve outlet and thermometer.
3. Description: Factory-fabricated, exposed-mounting, thermostatically controlled, water-mixing-valve assembly.
4. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
5. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
6. Component Pressure Ratings: 125 psig (860 kPa) minimum, unless otherwise indicated.
7. Selected Large Flow, Tempered Water Valve Size: 1-1/4 inlets with 1-1/2" outlet.
8. Tempered-Water Setting: 120 deg F (deg C).
9. Unit Tempered-Water Design Flow Rate: 24 gpm.
10. Unit Minimum Tempered-Water Design Flow Rate: 2.5gpm.
11. Unit Pressure Drop at Design Flow Rate: 15 psig.
12. Unit Tempered-Water Outlet Size: 3/4" NPS end connection.
13. Unit Hot- and Cold-Water Inlet Size: 3/4" NPS end connection.
14. Thermostatic Mixing Valve and Water Regulator Finish: Rough bronze.

2.4 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.

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8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with and cap with brass chain.

B. Stop-and-Waste Drain Valves:
1. Standard: MSS SP-110 for ball.
2. Pressure Rating: 200-psig (1380-kPa) minimum CWP or Class 125.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 (DN 6) side outlet with cap.

2.5 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:
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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. PPP Inc.
   b. Sioux Chief Manufacturing Company, Inc.
   c. Watts Drainage Products Inc.
   d. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASSE 1010 or PDI-WH 201.
4. Type: Copper tube with piston.
5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.1 HOSE BIBBS

A. Hose Bibbs in Restrooms:
1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following: Chicago Faucet model 293-E27CP.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Polished Chrome.
4. Seat: Slow Compression, replaceable.
5. Supply Connections: NPS 1/2 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig (860 kPa).
8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Chrome plated.
10. Finish for Service Areas: Chrome plated.
11. Finish for Finished Rooms: Chrome plated.
12. Operation for Equipment Rooms: Operating key.
13. Operation for Service Areas: Operating key.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include wall flange with each chrome-plated hose bibb.

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2.2 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:
   1. Available Manufacturers: Subject to compliance with requirements offering products that may be incorporated into the Work include, but a the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company.
      b. MIFAB, Inc.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.
      f. Woodford Manufacturing Company.
      g. Zurn Plumbing Products Group; Specification Drainage Operation.
   3. Standard: ASME A112.21.3M for concealed -outlet, self-draining wall hydrants.
   4. Pressure Rating: 125 psig (860 kPa).
   5. Operation: Loose key.
   6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
   7. Inlet: NPS 3/4.
   8. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
   9. Box: Deep, flush mounting with cover.
   10. Box and Cover Finish: Polished nickel bronze.
   11. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
   12. Nozzle and Wall-Plate Finish: Polished nickel bronze.
   13. Operating Keys(s): One with each wall hydrant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install thermometers and water regulators if specified.
   2. Install cabinet-type units recessed in or surface mounted on wall as specified.

C. Install water hammer arresters in water piping according to PDI-WH 201.

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or system.
   2. Backflow preventers shall be accessible from a standing position on the floor.

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3. Install drain for backflow preventers with atmospheric-vent drain connec fitting, fixed air-gap fitting, or equivalent positive pipe separation of diameters in drain piping and pipe to floor drain. Locate air-gap devi under backflow preventer. Simple air breaks are not acceptable for this a
4. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

C. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Electrical.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Primary, thermostatic, water mixing valves.
2. Primary water tempering valves.
3. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.1 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

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SECTION 221316 - SANITARY WASTE AND VENT PIPING

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 for soil, waste, grease waste, indirect waste, grease waste vent and sanitary vent piping inside the building including vents through the roof.

B. This Section includes the following for soil gas vent piping within the building including the vent above the roof.
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

B. Soil, Waste, and Vent Piping: 10-foot head of water 30 kPa or 5 psi.

1.4 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

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2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fit materials.

2.3 ABS PIPE AND FITTINGS

A. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.

B. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

C. Solvent Cement and Adhesive Primer:

1. Use Black ABS solvent cement that has a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
2. Solvent Cement and Adhesive Primer:
a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

3.2 PIPING APPLICATIONS

A. Aboveground, grease waste and vent, soil, waste and vent piping **NPS 4 (DN 100)** and smaller shall be the following:

1. Drainage piping and traps directly connected to the dishwashers: Copper DWV tube, copper drainage fittings, and soldered joints.
2. Exposed drainage piping within the two restaurant levels including under kitchen sinks and vents through the roof: Cellular-core Black ABS pipe, ABS socket fittings, and solvent-cemented joints.
3. Drainage and vent piping concealed above ceilings, within stud walls and in the basement level: Solid-wall, white Schedule 40 DWV PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

B. Underground, soil, waste, and vent piping **NPS 4 (DN 100)** and smaller shall be the following:

C. Schedule 40 Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

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3.3 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section ' Results for Plumbing."

B. Install cleanouts at grade and extend to where building sanitary drains cor sanitary sewers.

C. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

D. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

E. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

F. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Horizontal Sanitary Drainage Piping: ¼" per foot downward in direction of flow.
   2. Vent Piping: 1/8" per foot down toward vertical fixture vent or toward vent stack.

G. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

H. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 HANGER AND SUPPORT INSTALLATION

A. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

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B. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but
      required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping i
      but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes i
      smaller than required by plumbing code.

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
   5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging wit and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

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SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

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 sanitary drainage piping specialties:
   1. Cleanouts
   2. Floor Drains

PART 2 - PRODUCTS

2.1 FLOOR DRAINS

A. Floor Drains
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Watts or a comparable product by one of the following:
      a. Watts Drainage Products Inc.
      b. Zurn Industries
   2. FD-1: FD-100-7A, 2” no hub outlet, dura-coated cast iron body, 7” round polished nickel bronze grid strainer.
   3. Standard: ASME A112.6.3.
   4. Anchor Flange: Required.
   5. Outlet: Bottom.
   6. Trap Material: Same material as connected piping.
   7. Trap Pattern: Standard P-trap.

2.2 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Air-Gap Fittings :

   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.
   5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" fo materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 100 feet for all piping.
   4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

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SECTION 221613 - FACILITY NATURAL-GAS PIPING

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. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Solenoid Gas Valves.
6. Mechanical sleeve seals.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
1. Piping and Valves: 40 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Buildings: 7” water column.

C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 SUBMITTALS

A. Product Data: For each type of the following:
1. Piping specialties.
2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
3. Dielectric fittings.

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4. Mechanical sleeve seals.
5. Escutcheons.

B. Coordination Drawings: Plans and details, drawn to scale, on which natu shown and coordinated with other installations, using input from installe involved.

C. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

D. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes 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.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.7 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   a. Material Group: 1.1.
   b. End Connections: Threaded or butt welding to match pipe.
   c. Lapped Face: Not permitted underground.

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d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, al and spiral-wound metal gaskets.
e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground an underground.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:
1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches (1830 mm).

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 psig (862 kPa.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
1. CWP Rating: 125 psig (862 kPa).
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

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1. Manufacturers: Subject to compliance with requirements, availabl offering products that may be incorporated into the Work include, but a the following:
   a. Watts
   b. Nibco
   c. Conbraco Industries, Inc.; Apollo Div.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig (4140 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 SOLENOID GAS VALVES

A. Electrically Operated Valves: Comply with UL 429.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Basis-of-Design Product: Subject to compliance with requirements, provide ASCO or comparable product by one of the following:
         1) ASCO Power Technologies, LP; Division of Emerson.
         2) Magnatrol Valve Corporation
         3) Watts Regulator Co.; Division of Watts Water Technologies, Inc.
         4) ISIMET, LLC.
   2. Model: Series JB8214C-CSA.
   3. Size: 2” rated for 2,940,500 btu/hr.
   4. Pilot operated.
   5. Body: Aluminum.
   6. Seats and Disc: Nitrile rubber.
   7. Springs and Valve Trim: Stainless steel.
   8. 120-V ac, 60 Hz, (Kitchen Gas Valve).
   9. NEMA ICS 6, Type 4, coil enclosure.
   10. Normally closed.

2.6 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

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2.7 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to f between pipe and sleeve.
   1. Manufacturers: Subject to compliance with requirements, availabl offering products that may be incorporated into the Work include, but a the following:
      a. Advance Products & Systems, Inc.
      b. Calpico Inc.
      c. Metraflex Company (The).
      d. Pipeline Seal and Insulator, Inc.
   2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
   3. Pressure Plates: Carbon steel.
   4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.8 ESCUTCHEONS

A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.

B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Escutcheons: With set screw.
   1. Finish: Polished chrome-plated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

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B. Install piping in concealed locations unless otherwise indicated and except in e and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and serv angles or parallel to building walls. Diagonal runs are prohibited unless speci otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Locate valves for easy access.

F. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install escutcheons at penetrations of interior walls, ceilings, and floors.
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      c. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      d. Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
      f. Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      g. Piping in Equipment Rooms: One-piece, cast-brass type.
      h. Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

J. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Through-Penetration Firestop Systems."

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
   1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

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O. Concealed Location Installations: Except as specified below, install conce piping and piping installed under the building in containment conduit construc with welded joints as described in Part 2. Install a vent pipe from contain outdoors and terminate with weatherproof vent cap.
   1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and re installed in accessible spaces without containment conduit.
   2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
      a. Exception: Tubing passing through partitions or walls does not require striker barriers.
   3. Prohibited Locations:
      a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
      b. Do not install natural-gas piping in solid walls or partitions.

P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

Q. Connect branch piping from top or side of horizontal piping.

R. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

S. Do not use natural-gas piping as grounding electrode.

T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

U. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.4 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.5 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:
   1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
   2. Cut threads full and clean using sharp dies.
   3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.

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4. Apply appropriate tape or thread compound to external pipe thread threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that damaged. Do not use pipe sections that have cracked or open welds.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

B. Comply with requirements for pipe hangers and supports specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).

3.7 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.8 LABELING AND IDENTIFYING

A. Comply with requirements in Division 22.

3.9 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.

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B. Paint exposed, exterior metal piping, valves, service regulators, service meters earthquake valves, and piping specialties, except components, with factory-protective coating.
   1. Alkyd System: MPI EXT 5.1D.
      a. Prime Coat: Alkyd anticorrosive metal primer.
      b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
      c. Topcoat: Exterior alkyd enamel (semigloss).
      d. Color: Gray to match gas utility equipmnt.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Test, inspect, and purge natural gas according to NFPA 54and the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 OUTDOOR PIPING SCHEDULE

A. Aboveground natural-gas piping shall be the following:
   1. Steel pipe with wrought-steel fittings and joints.

3.12 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (14" water column)

A. Aboveground, branch piping NPS 1 (DN 25) and smaller shall be the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.

3.13 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 (DN 50) and smaller at service meter shall be the following:
   1. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 (DN 65) and larger at service meter shall be the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.

C. Distribution piping valves for pipe sizes NPS 2 (DN 50) and smaller shall be the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.

D. Distribution piping valves for pipe sizes NPS 2-1/2 (DN 65) and larger shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.

E. Valves in branch piping for single appliance shall be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

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SECTION 223400 - FUEL-FIRED DOMESTIC WATER HEATERS

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 fuel-fired water heaters:
   1. Commercial, high-efficiency, gas water heaters.
   2. Water heater accessories.

1.3 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. LEED Submittal:
   1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with ASHRAE/IESNA 90.1-2004, Section 7 - "Service Water Heating."

C. Shop Drawings: Diagram power, signal, and control wiring.

D. Product Certificates: For each type of commercial water heater, signed by product manufacturer.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For water heaters to include in emergency, operation, and maintenance manuals.

H. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. 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.

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D. ASHRAE/IESNA 90.1-2004Compliance: Applicable requirements in ASHR
2004.

E. ASME Compliance:
1. Where ASME-code construction is indicated, fabricate and label comme
storage tanks to comply with ASME Boiler and Pressure Vessel Cod
Division 1.
2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.5 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired water heaters that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period(s): From date of Substantial Completion:
a. Commercial, Gas Water Heaters:
1) Storage Tank: Five years.
2) Controls and Other Components: Five years.

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 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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Commercial, High-Efficiency, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.

1. Available Manufacturers:
a. AERCO International.
b. Lochinvar Corporation.
c. Rheem Water Heater Div.; Rheem Manufacturing Company.

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d. Smith, A. O. Water Products Company.

2. Basis for design: A.O Smith Cyclone Xi, model BTH-199, natural gas.
3. Description: Manufacturer's proprietary design to provide at least 95 pe efficiency at optimum operating conditions. Following features and a modified or omitted if water heater otherwise complies with r performance.
4. Tank Construction: ASME-code steel with 150-psig (1035-kPa) minimum working-pressure rating.
   a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
      1) NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
   b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Lining: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
   d. Features: Sealed combustion, submerged combustion chamber with helical heat exchanger coil, LCD control and diagnostic display.
5. Factory-Installed, Storage-Tank Appurtenances:
   a. Anode Rod: Replaceable magnesium.
   b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
   c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
   d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
   e. Jacket: Steel with enameled finish.
   f. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
6. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for high-efficiency water heaters and for natural gas fuel.
7. Temperature Control: Adjustable thermostat.
8. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
9. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.
10. Capacity and Characteristics:
    a. Capacity: 100 gal. (L).
    b. Recovery: 230 gph (L/s)> at 100 deg F (56 deg C temperature rise.
    c. Temperature Setting: 140 deg F (60 deg C.
    d. Fuel Gas Input: 199,000 Btu/h (W).>
    e. Gas Pressure Required at Burner: 7 to 13” inches (mm)> water column for natural gas.
    f. Electrical Characteristics:
       1) Volts: 120.
       2) Phase: Single.
       3) Hertz: 60.
       4) Full-Load Amperes: 2.2 for blower, 4.0 for igniter.
    g. Minimum intake and exhaust Vent Diameter: 4”

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2.2 WATER HEATER ACCESSORIES

A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish f piping.

B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rati pressure differential required between gas supply and water heater.

C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.

D. Combination Temperature and Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select each relief valve with sensing element that extends into storage tank.
   1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.

E. Pressure Relief Valves: Include pressure setting less than working-pressure rating of water heater.

F. Gas Water Heaters: ANSI Z21.22/CSA 4.4.

2.3 SOURCE QUALITY CONTROL

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

C. Prepare test reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.
   1. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install gas water heaters according to NFPA 58.

D. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.

E. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.

F. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.

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G. Install combination temperature and pressure relief valves in top portion of st relief valves with sensing elements that extend into tanks. Extend commerc relief-valve outlet, with drain piping same as domestic water piping in contir pitch, and discharge by positive air gap onto closest floor drain.

H. Install combination temperature and pressure relief valves in water piping f without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

I. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.

J. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

K. Install pressure gage(s) on inlet and outlet piping of commercial, fuel-fired water heater piping. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

L. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves and to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

M. Fill water heaters with water.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

C. Ground equipment according to Division 26 Section 260170 "Grounding and Bonding."

D. Connect wiring according to Division 26 Section 260123 "Wire and Cable".

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
   1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, confirm proper operation.

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3. Test and adjust controls and safeties. Replace damaged and malfunctioı equipment.

C. Remove and replace water heaters that do not pass tests and inspections and r above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial water heaters. Refer to Division 01 Section "Demonstration and Training."

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SECTION 224000 - PLUMBING FIXTURES

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 conventional plumbing fixtures and related components:
   1. Faucets for lavatories.
   2. Water closets.
   3. Lavatories.
   4. Commercial Sinks.

B. Related Sections include the following:
   1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

C. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

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1. Exception: If fixtures, faucets, or other components are not availab manufacturer, obtain similar products from other manufacturers sp category.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Acces Buildings and Facilities"; Public Law 90-480, "Architectural Barriers A Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

F. Comply with the following applicable standards and other requirements specified for sink faucets:
   1. Faucets: ASME A112.18.1.
   2. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
   3. NSF Potable-Water Materials: NSF 61.
   4. Pipe Threads: ASME B1.20.1.
   5. Supply Fittings: ASME A112.18.1.
   6. Brass Waste Fittings: ASME A112.18.2.

G. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
   1. Atmospheric Vacuum Breakers: ASSE 1001.
   2. Brass and Copper Supplies: ASME A112.18.1.
   3. Brass Waste Fittings: ASME A112.18.2.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures of unit shell.
      b. Faulty operation of controls, blowers, pumps, heaters, and timers.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Period for Commercial Applications: Three year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets: L-1.

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a. Basis-of-Design Product: Subject to compliance with requir Kohler "Purist" model K-14402-4-BV. Description: ADA cc control lavatory faucet shall be made of brass construction. Proc maximum flow rate of 1.5 gallons (5.7 L) per minute. Product sh piece, self-contained ceramic disc valve, allowing volume and tem Product shall feature temperature memory, allowing the faucet to off at any temperature setting, and a high-temperature limit setting for added safety. Product shall be for single-hole mounting. Product shall feature a 5-1/2″ (14 cm) spout reach, low spout design, a stationary spout.
b. Install a polished chrome plated grid strainer with ADA offset in lieu of the pop-up drain and tailpiece.
c. Body Material: Commercial, solid brass.
d. Finish: Vibrant Brushed bronze.
e. Maximum Flow Rate: 1.5 gallon per minute.
f. Mounting: Single hole, faucet deck mounted.
g. Inlet(s): NPS 1/2 (DN 15).
h. Spout: Rigid type.
i. Operation: Single handle manual operation.

2.2 WATER CLOSETS

A. Water Closets, WC-1:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Kohler, or a comparable product by one of the following:
   a. American Standard Companies, Inc.
   b. Kohler Co.
   c. Toto
2. Description Model K-3754-0 with K-9385-BV handle, elongated high efficiency wall hung toilet, "Right Height", two piece tank type with manual flush handle on the left side.
   a. Supply: NPS 1/2" chrome-plated brass or copper with screwdriver stop.
   b. Bowl Type: Elongated.
   c. Trapway: 2-1/8" minimum glazed.
   d. Design Consumption: 1.6 gal./flush.
   e. Color: White.
   f. Seat: White elongated, open front, less seat.
   g. Flush Handle: Replace chrome plated handle with K-9385 Vibrant Brushed Bronze finish.
   h. MaP Flush Performance Rating: 1,000 grams.

2.3 LAVATORIES

A. Lavatory L-1:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Porcher lavatory:
2. Description: Model 20000-01, single center faucet hole, accessible, wall mounted, fine fire clay fixture.
   a. Type: Wall hung.
   b. Fixture Size: 21" front-to-back by 26" wide.
   c. Basin Size: 15-3/4" front-to-back by 18-1/4" wide by 5-1/2" deep.
   d. Color: White.

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e. Faucet: See specification section 2.1-A.
f. Supplies: Insulated NPS 3/8 (DN 10) chrome-plated copper wit escutcheons.
g. Drain: Chrome Plated Grid Strainer.
h. Drain Piping: Chrome Plated NPS 1-1/4" ADA offset, chrome-pl x 1-1/2" cast-brass P-trap; NPS 1-1/2 (DN 40) tubular brass wa wall escutcheon.
i. Insulation: Not required.

2.4 INSTANTANEOUS HOT WATER HEATER AND FAUCET

A. Instantaneous heater and faucet:
1. Basis-of-Design Product: Subject to compliance with requirements, provide In-Sinkerator model C1300.
2. Description: Foodservice grade heating element provides 100 cups of near-boiling water per hour.
a. Swiveling gooseneck spout travels 90° to provide clearance for large vessels.
b. Easy-action lever with automatic shut-off.
c. Brass faucet with polished chrome finish.
d. 2/3-gallon Stainless Steel Tank construction.
e. Adjustable temperature control on front panel.
f. Mounts in standard sink opening or 1-1/4" drilled hole
g. 1-year full warranty on parts and labor.
h. Capacity: 2/3-gallon tank dispenses 100 cups of 200ºF water per hour.
i. Electrical 120 Volts A.C., 1300 Watts, 10.8 amp heating element with 36" cord and grounded plug
j. Thermostat Snap action, adjustable from 160°F to 210ºF (factory pre-set at approximately 200°F)
k. Insulation Meets U.L. 94HF-1 flammability specification
l. Mounting: Mount the heater directly below the counter. Maximum distance_ between tank and base of faucet should be 14-1/2" or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

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B. Install water-supply piping with stop on each supply to each fixture to be co distribution piping. Attach supplies to supports or substrate within pipe spaces Install stops in locations where they can be easily reached for operation.

C. Install trap and tubular waste piping on drain outlet of each fixture to be direc sanitary drainage system.

D. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

E. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust high temperature limit stops on faucets. Replace damaged and malfunctioning units.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
   1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
   2. Remove sediment and debris from drains.

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B. After completing installation of exposed, factory-finished fixtures, faucets, and exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities.

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SECTION 230500 – COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Provide labor, materials, accessories, and other related items as required to complete operations in connection with the complete installation of the HVAC and mechanical systems as indicated on the Drawings and as specified herein.

1.2 RELATED REQUIREMENTS

A. Conditions of the Contract apply to the work, including the work of this Division. Examine Contract Documents for requirements affecting the work.

B. Provide cooperation with, and assistance to, the Commissioning Agent as specified under "Responsibilities" in Division 01 Section "General Commissioning Requirements."

C. Provide cooperation with, and assistance to, the Testing and Balancing (TAB) Agent specified in Division 23 Section "Testing, Adjusting, and Balancing for Mechanical Systems."

1.3 DRAWINGS

A. The general location of the apparatus and the details of the work are indicated on the Drawings. Exact locations not indicated shall be determined at the site as the work progresses and shall be subject to the Architect's approval.

B. It is not intended that the Drawings shall show every pipe, pipe rise, pipe drop, duct rise, duct drop, pipe fitting, duct fitting, or appliance, but it shall be a requirement to furnish, without additional expense, material and labor necessary to complete the systems in accordance with the design intent and with the highest possible quality available.

1.4 ALTERATIONS

A. Execute alterations, additions, removals, relocations, new work, and other related items as indicated or required to provide a complete installation in accordance with the intent of the Contract Documents, including changes required by building alterations.

B. Existing work disturbed or damaged by the alterations or the new work shall be repaired or replaced to the Architect's satisfaction and at no additional cost to the Owner.

C. Existing ductwork, piping, and other systems indicated to be removed, shall be removed from the site. Cap off existing services remaining. The Owner retains the right to ownership of heating and ventilating equipment scheduled to be removed; store such equipment where requested by the Owner. Material not retained by the Owner shall be removed from the site.

1.5 CONTINUITY OF SERVICE

A. Arrange to execute the work at such times and in such locations as may be required to provide uninterrupted service for the building or any of its locations. Any unavoidable conditions requiring reduced building capacity shall be arranged for by programming with the Owner's

duly authorized representative at the building subject to the Architect's appro necessary, temporary work shall be installed to provide for the condition. Au interrupting service shall be obtained in writing from the Owner. Any interru service shall be performed during an overtime period to be scheduled with the for overtime work shall be included in the Bid.

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1.6 REQUIREMENTS

A. Installation Instructions: Obtain manufacturer's printed installation instructions to aid in properly executing work on major pieces of equipment. Install equipment in accordance with manufacturer's recommendations.

B. Objectionable Noise, Fumes and Vibration:
   1. Mechanical and electrical equipment shall operate without creating objectionable noise, fumes, or vibration, as determined by the Architect.
   2. If such objectionable noise, fumes, or vibration is produced and transmitted to occupied portions of building by apparatus, piping, ducts, or any other part of mechanical and electrical work, make necessary changes and additions, as approved, without extra cost to Owner.

C. Equipment Design and Installation:
   1. Uniformity: Unless otherwise specified, equipment or material of same type or classification, used for same purposes, shall be product of same manufacturer.
   2. Design: Equipment and accessories not specifically described or identified by manufacturer's catalog number shall be designed in conformity with ASME, IEEE, or other applicable technical standards, suitable for maximum working pressure, and with neat and finished appearance.
   3. Installation: Erect equipment aligned, level and adjusted for satisfactory operation. Install so that connecting and disconnecting of piping and accessories can be made readily, and so that parts are easily accessible for inspection, operation, maintenance and repair. Minor deviations from indicated arrangements may be made, as approved.

D. Protection of Equipment and Materials: Responsibility for care and protection of materials and mechanical work rests with the Contractor until the entire project has been completed, tested and the project is accepted by the Owner.

E. Foundations:
   1. Where floor mounting is indicated, locate equipment on 4 inch (102 mm) high reinforced concrete pad of adequate size with anchors and base plates as required. The corners of pads shall be chamfered 1 inch (25 mm). Pad and steel sizes and location shall be coordinated with the approved equipment.

1.7 ELECTRIC WORK

A. Provide motors, pilot lights, controllers, limit switches, and other related items for equipment provided under Division 23.

B. Except as noted, required line switches, fused switches, and other related items and necessary wiring to properly connect equipment to motors and switches shall be furnished and installed under Division 26, Electric.

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C. Provide complete wiring system for automatic temperature controls as specifi Division 23 Section "Instrumentation and Controls for Mechanical Systems."

D. Wiring shall conform to the requirements of the National Electrical Code.

1.8 FIRESTOPPING

A. Firestopping for penetrations of ductwork, piping and equipment through building assemblies, including but not limited to partitions, walls, floors, ceilings, and roofs, shall be furnished and installed under this Section.

B. Selection of firestopping materials and installation of firestopping materials shall be in accordance with Division 07 Section "Through Penetration Firestop Systems." Coordinate with other trades for a consistent installation.

1.9 SUBMITTALS

A. After award of Contract and before installation, submit for approval Shop Drawings, bulletins, Product Data, Samples, and other related items.

B. Submit Shop Drawings and Product Data as required in each Section. Submittal shall include physical data and performance data required to verify compliance with the Contract Documents.

C. Submit Samples as required in each Section, and as indicated on the Drawings. These will generally be retained by the Architect/Engineer, unless otherwise indicated. Contractor may request these items returned; provide return shipping for returns.

D. Architect/Engineer's review will not include the review, coordination, or verification of dimensions or quantities; these shall be the responsibility of the Contractor.

1.10 SUBMITTAL PROCEDURES

a. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
   (1) Submit electronic submittals by either of the following methods:
      (a) Via email as PDF electronic file to **submittals@harriman.com** .
         1) Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
      b. Post electronic submittals as PDF electronic files directly to Architect's FTP site specifically established for Project.
         1) Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

1.11 SUBSTITUTIONS

A. Comply with provisions of the General Requirements

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B. The first item listed under "Acceptable Manufacturers", "Approved Manufact
"Manufacturers" is the design basis.
   1. Other manufacturers listed may be used in the base Bid, but conformance
   the Specifications, as well as dimensional and electrical data, shall be ver
   Contractor.
   2. Architect/Engineer has not verified that each listed manufacturer has the
   provide an acceptable substitution for the basis-of-design product. Contractor may not assume that substitutions will be approved.
   3. Modifications required as a result of differences between the design basis item and the submitted and approved item must be approved by the Architect and made at the Contractor's expense. As an example, if a rooftop HVAC unit is submitted and approved and if the unit's dimensions and weight are different from those of the unit which was used as the design basis, the Contractor shall be responsible for building structural modifications required to accommodate the submitted and approved unit, at no additional cost to the Owner.
   4. For items which have no manufacturers listed, any item conforming with the Contract Documents is acceptable.

C. Substitutions from manufacturers or providers which are not listed may be proposed within the time allowed in the General Conditions of the Specifications.
   1. The exception to this is products for which the list of manufacturers or providers is limited by the wording "no substitutions" or similar wording.

1.12 COORDINATION

A. Coordinate scheduling, submittals, and Work of the various Sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Verify that utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various Divisions having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

C. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

D. In finished areas, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

E. Coordinate completion and clean-up of work of separate Sections in preparation for Substantial Completion.

F. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.13 CLEANING

A. Remove debris from site daily.

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B. Material and pieces of equipment shall be turned over to the Owner free of du
inside and out.

C. At the completion of the Project, equipment shall have a clean, neat appearan
finish by cleaning or repainting as required.

D. At the completion of the Project, surfaces exposed to view shall have a clean, neat appearance of finish free from smudges and scratches by cleaning or repainting as required.

1.14 STARTING SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect/Engineer 7 days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.

D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of responsible manufacturer's representative in accordance with manufacturer's instructions.

G. When specified in individual Specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

1.15 FACTORY START-UP AND START-UP REPORTS

A. Provide factory start-up of mechanical equipment listed below. Factory start-up shall be performed by a factory authorized representative of the equipment manufacturer. When factory start-up is successfully completed for each piece of mechanical equipment listed below, submit a formal start-up report to the Architect for approval. Start-up report shall be formatted in accordance with equipment manufacturer's recommendations. Start-up report shall be typed, not hand written, and shall be submitted in a clean and legible form.

B. Equipment requiring factory start-up
   1. Air handling units
   2. Boilers
   3. Kitchen Hood Fire Suppression Systems.

1.16 ADJUSTMENTS AND OWNER'S INSTRUCTIONS

A. After completion of the installation work called for in the Contract Documents, furnish necessary mechanics or engineers for the adjustment and operation of the systems, to the end

that the systems are perfectly adjusted and turned over to the Owner in perfec
Further instruct the Owner's authorized representative in the care and operatic
installation, providing framed instruction charts, directions, and other related

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B. Instructors providing Owner training shall be experienced and familiar with tl

1.17 TESTING

A. After the entire installation is completed and ready for operation, test the systems as outlined in Division 23 Section "Testing, Adjusting and Balancing for HVAC." These tests are supplementary to detailed tests specified herein or directed. The Owner will provide water and electric current for the test. Provide necessary labor, test pump, gauges, meters, other instruments, and materials. Perform tests in the presence of the Architect or his representative.

B. Perform other tests specified in individual Sections of this Specification.

1.18 COMPLETION OF SYSTEMS

A. The following mechanical systems shall not be complete until the following conditions are satisfied:
   1. Ductwork Systems:
      a. Ductwork and related components and accessories shall be completely installed and insulated as specified.
      b. Ductwork leakage testing shall be completed and leakage testing reports shall be submitted and approved.
      c. Ductwork shall be balanced and a balancing report shall be submitted and approved.
      d. Commissioning shall be completed.
   2. Piping Systems:
      a. Piping, valves and accessories shall be completely installed, insulated and labeled as specified.
      b. Piping pressure testing be completed and pressure testing reports shall be submitted and approved.
      c. Piping systems shall be balanced and a balancing report shall be submitted and approved.
      d. Commissioning shall be completed.
   3. Equipment:
      a. Equipment, including but not limited to boilers, heat exchangers, terminal heat transfer units, pumps, air handling units, condensing units, chillers, split system air conditioning equipment, and exhaust fans, shall be completely installed.
      b. Equipment start-up reports shall be completed, submitted and approved.
      c. Equipment balancing shall be completed and the balancing report shall be submitted and approved.
      d. Commissioning shall be completed.
   4. Automatic Temperature Controls (ATC):
      a. ATC system shall be completely installed.
      b. Commissioning shall be completed.
      c. ATC system shall operate in an automatic mode for a minimum of 4 months during Owner occupancy without substantial deficiencies.

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1.19 OPERATING AND MAINTENANCE MANUALS

A. Furnish quantity required in Division 01 of the Specifications, of bound opera maintenance manuals. Deliver to the Architect for review. Required quantity Owner; the Architect will not retain a bound copy.

B. For maintenance purposes, provide approved Submittals, parts lists, specifications, and manufacturer's maintenance bulletins for each piece of equipment. For materials used which have been submitted to the Architect for approval but do not require regular maintenance, such as piping, ductwork, and insulation, provide one copy of approved Submittals.

C. Provide name, address and telephone number of the manufacturer's representative and service company, for each piece of equipment or material so that service or spare parts can be readily obtained.

1.20 WARRANTY

A. Provide guarantees and warranties for work under this Contract as indicated in the general requirements of the Contract.

B. Provide manufacturers' standard warranties and guarantees for work by the mechanical trades. However, such warranties and guarantees shall be in addition to and not in lieu of other liabilities which the manufacturer and the Mechanical Contractor may have by law or by other provisions of the Contract Documents.

C. Guarantee that elements of the systems provided under this Contract are of sufficient capacity to meet the specified performance requirements as set forth in these Specifications or as indicated on the Drawings.

D. Upon receipt of notice from the Owner of failure of any part of the mechanical systems or equipment during the warranty period, the Mechanical Subcontractor shall replace the affected part or parts.

E. Furnish a written guarantee covering the above requirements before submitting the application for final payment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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SECTION 230513 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMEN

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Common requirements for electric motors furnished on equipment specified in other Sections, including single phase and three phase electric motors.

B. Starters.

C. Thermal Overload Protection.

D. Belt Drives.

E. Variable Speed Drives.

1.2 REFERENCES

A. Division 01 Section “References”: Requirements for references and standards.

B. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

C. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

D. NEMA MG 1 - Motors and Generators.

E. NFPA 70 - National Electrical Code.

F. UL 508A - Industrial Control Panels.

G. UL 674 - UL Standard for Safety Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.

H. UL 1836 - UL Standard for Safety for Electric Motors for Use in Class I, Division 2 and Class II, Division 2 Hazardous (Classified) Locations.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

1.4 REGULATORY REQUIREMENTS

A. Conform to UL Component Recognition for appropriate sizes.

B. Conform to NFPA 70 and local energy code.

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1.5 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section "Product Requirements": Transport, handle, store, and pro

B. Protect motors stored on site from weather and moisture by maintaining factory suitable weather-proof covering. For extended outdoor storage, remove motors and store separately.

PART 2 - PRODUCTS

2.1 MOTORS

A. Acceptable Manufacturers:
1. A.O. Smith.
2. Baldor.
3. Emerson Motor Technologies.
4. General Electric.
5. Greenheck Fan Corporation.
6. Marathon Electric.
7. Siemens.
8. Teco-Westinghouse.
9. Toshiba.
10. U.S. Motors (division of Emerson Motor Technologies).
11. WEG.

B. General Construction and Requirements:
1. Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer's standard and need not conform to these Specifications.
2. Motors shall have integral thermal overload protection.
3. Single Phase Motors for general applications: PSC (permanent split capacitor) where available.
4. Single Phase Motors for fans:
   a. EC (electronically commutated) where available.
   b. PSC (permanent split capacitor) where available, if EC is not available.]
5. Open drip-proof type except where specifically noted otherwise.
6. Design for continuous operation in 40 degrees C environment.
7. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
8. Explosion-Proof Motors: UL approved for hazard classification.
9. Visible Nameplate: Indicating manufacturer's name and model number, motor horsepower, RPM, frame size, voltage, phase, cycles, full load amps, insulation system class, service factor, maximum ambient temperature, temperature rise at rated horsepower, minimum efficiency.

C. Inverter Duty: Motors for use with variable frequency drives shall be rated for "inverter duty", with winding insulation rated for 1600 Volts and Class H (180 degrees C) temperature rating.

D. Single-Phase Power for Fans - Electronically-Commutated (EC) Motors - Also Known As Brush-Free DC (BFDC) Motors:
1. Drive: Direct-drive only, not for use with belt drive.

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2. Power Supply: Internal motor circuitry shall convert AC power supplied operate the motor.
3. Turndown: Speed-controllable down to 20 percent of full speed (80 perc
4. Speed Control: Integral potentiometer with screwdriver setting, remote p dial with 24 VDC transformer to generate a 0-10 VDC signal, or integral accept a 0-10 VDC signal from the building control system, as indicated
5. Efficiency: Minimum of 85 percent efficient at all speeds.
6. Soft-start type, capable of reliable start at any speed setting.
7. Enclosure: Open drip-proof.
8. Bearings: Permanently lubricated heavy duty ball bearings.
9. Overload Protection:
   a. Automatic Speed Control: In the event of overheating or overloading, the motor electronics slow the motor to operate within its acceptable range.
   b. Thermal Overload: Internally fused, one-shot type as a last resort to prevent fires.
   c. Locked Rotor: If the motor sees a locked rotor condition, it will automatically shut itself down, then try to restart 3 times. After the 3rd try, the motor will not attempt to restart until the power is cycled.]

E. Single Phase Power - Permanent-split Capacitor Motors:
1. Starting Torque: Exceeding one fourth of full load torque.
2. Starting Current: Up to six times full load current.
3. Multiple Speed: Through tapped windings.
4. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

F. Single Phase Power - Capacitor Start Motors:
1. Starting Torque: Three times full load torque.
2. Starting Current: Less than five times full load current.
3. Pull-up Torque: Up to 350 percent of full load torque.
4. Breakdown Torque: Approximately 250 percent of full load torque.
5. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
6. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated bearings.
7. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

G. Single Phase Power - Split Phase Motors:
1. Starting Torque: Less than 150 percent of full load torque.
2. Starting Current: Up to seven times full load current.
3. Breakdown Torque: Approximately 200 percent of full load torque.
4. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
5. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

H. Three Phase Power - Squirrel-cage Motors:
1. Starting Torque: Between 1 and 1-1/2 times full load torque.
2. Starting Current: Six times full load current.

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3. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: N characteristics.
4. Design, Construction, Testing, and Performance: Conform to NEMA M energy-efficient motors.
5. Insulation System: NEMA Class B or better.
6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast ir brackets of cast iron or aluminum with steel inserts.
7. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
8. Sound Power Levels: To NEMA MG 1.
9. Part Winding Start Above 254T Frame Size: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
10. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
11. Nominal Efficiency: To NEMA MG 1, energy efficient for motor sizes 10 and larger.

2.2 STARTERS AND OVERLOADS

A. Acceptable Manufacturers:
1. Cerus Industrial, Inc.
2. Allen-Bradley (division of Rockwell Automation).
3. Cutler Hammer (division of Eaton Corporation).
4. General Electric.
5. Siemens.
6. Square D (division of Schneider Electric).

B. Provide motor starters for motors provided under this Division of these Specifications.

C. Cerus Industrial "BAS" building automation HVAC starters are the basis of design. Features of starters/contactors, disconnects, and temperature controls shall be combined in a single package using these starters. Coordination with Automatic Temperature Controls supplier and installer is required to reduce total project costs.
1. 3-phase starter features include:
   a. Multi-tap control power transformer (CPT) for universal control voltage.
   b. Motor circuit protector disconnect (MCP) with high interrupt rating and lockable operator handle.
   c. Contactors rated as high as 2.5 million electrical operations and 25 million mechanical operations.
   d. Anti-cycling feature.
   e. Solid-state electronic overloads with wide adjustment range and highly accurate digital motor protection, including protection for phase loss, phase unbalance, stall and locked rotor conditions. Class 1-30.
   f. Digital keypad, featuring an H-O-A (Hand, Off, Auto) panel with large, clearly labeled push buttons including a front panel reset function and high-intensity LED indicators for settings.
   g. Damper and valve actuator control, to open the actuator before starting the fan or pump motor.

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h. Permissive auto control to disable auto inputs. Commonly used w pressure limit switch.
i. Universal control inputs, including auto dry input, and wet input fo 20 to 138 VAC or VDC.
j. Power failure reset.
k. Fireman's override.
l. NEMA 1 enclosure with prepunched knockouts. NEMA 3R, 4, 4X, and 12 as required.
m. BACnet embedded communications option available.
n. UL Listed assembly.
o. 5-year warranty.
p. Factory printed label or engraved nameplate, designating the equipment served.

2. Single-phase starter (Cerus BAS-1P series) features include:
   a. Manually operated quick-make toggle mechanism lockable in the "Off" position, which shall also function as the motor disconnect.
   b. Hand/Auto switch, concealed behind sliding cover to discourage tampering.
   c. Capability to operate in both manual and automatic control modes. In automatic mode, the starter shall have the capability to integrate with a building automation system by providing terminals for run input, run status output, and fault output.
   d. Control terminals integrated in the starter.
   e. Power, run status, and fault LED pilot lights.
   f. Interposing run relay and current sensing status output relay.
   g. Voltage and dry inputs for auto run command.
   h. System override mode (fireman's, occupancy, or manual).
   i. Solid-state electronic overload with wide adjustment range and highly accurate digital motor protection, including protection for stall and locked rotor conditions. Class 10. Concealed adjustment behind sliding cover.
   j. Surface mount enclosure, UL Type 1, single gang box installation, with sliding covers for concealed items.
   k. Power Input: 1-phase, 110-240 VAC, 1-16 Amps, 0.1-1 HP (75 to 745 W).
   l. Universal Control Inputs: Voltage auto-run 10-130 VAC/DC to energize. Dry auto-run normally-open dry contact closure.
   m. Control Outputs: Proof of run and fault, normally-open 0.3 Amps at 125 VAC, 1 Amp at 24 VAC.
   n. Ambient operating temperature -5 to 140 degrees F (-20 to 60 degrees C).
   o. UL 508A Listed.
   p. 5-year warranty.

D. At Contractor's option, Cerus Industrial "EMS" energy management HVAC starters may be provided. Features of starters/contactors, disconnects, and temperature controls, and power metering, shall be combined in a single package using these starters. Coordination with Automatic Temperature Controls supplier and installer is required to reduce total project costs. Starter features include:
   1. True power measurement with integrated current transformers (CTs) to detect belt loss and alert the building automation system.
   2. Power metering, 1percent ANSI grade accuracy, with pulse/analog output of kW/kWh. Pulse output: normally-open contact, up to 45 V, up to 8 ohms resistance. Analog output of kW: 4-20 mA. LCD Display of kW and kWh.
   3. [BACnet embedded communications, RS-485 MS/TP half-duplex data transmission, with 30 points including metering value objects, binary value objects, multi-state objects, and analog value objects.

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4. Multi-tap control power transformer (CPT) for universal control voltage.
5. Motor circuit protector disconnect (MCP) with high interrupt rating and l handle.
6. Contactors rated as high as 2.5 million electrical operations and 25 millic operations.
7. Anti-cycling feature.
8. Solid-state electronic overloads with wide adjustment range and highly accurate digital motor protection, including protection for phase loss, phase unbalance, stall and locked rotor conditions. Class 1-60.
9. LCD 16-character 2-line display with backlight, plain English operation, with selectable readouts including power metering attributes and overload settings.
10. Digital keypad, featuring an H-O-A (Hand, Off, Auto) panel with large, clearly labeled push buttons including a front panel reset function and high-intensity LED indicators for settings.
11. Damper and valve actuator control, to open the actuator before starting the fan or pump motor.
12. Permissive auto control to disable auto inputs. Commonly used with a high pressure limit switch.
13. Fireman's override.
14. Power failure reset.
15. NEMA 1 enclosure with prepunched knockouts. NEMA 3R, 4, 4X, and 12 as required.
16. Power Input: 3-phase, 200-600 VAC, 0.5-95 Amps, 1-200 HP (0.75 to 149 kW).
17. Universal Control Inputs: Voltage auto-run, and fireman's override, 10-130 VAC/DC to energize. Dry auto-run, damper position switch, permissive auto, and shutdown, normally-open dry contact closure.
18. Control Outputs: Proof of run and fault, normally-open 0.3 Amps at 125 VAC, 1 Amp at 24 VAC. Damper and valve control, 1 Amp at 24 VAC (or 120 VAC).
19. Ambient operating temperature -5 to 140 degrees F (-20 to 60 degrees C).
20. UL Listed assembly.
21. 5-year warranty.
22. Factory printed label or engraved nameplate, designating the equipment served.]

E. Feature Descriptions:
1. Fireman's Override Input: Causes the starter to run the motor in any mode (Hand, Off or Auto) regardless of other inputs or lack of inputs either manual or auto. The purpose of the Fireman's Override input is to act as a smoke purge function. Fireman's Override has priority over the Emergency Shutdown input.
2. Emergency Shutdown Input: Disables the starter from operating in either Hand or Auto mode regardless of other inputs either manual or auto.
3. Phase Failure Protection: Initiates when phase loss is greater than 70 percent for 3 seconds or phase unbalance is greater than 50 percent for more than 5 seconds.
4. Cycling Fault Protection: Activates whenever the starter is cycled at a rate of more than 1000 cycles in a one hour period. This feature shall be selectable to be disabled. Cycling fault shall cause overload LED to blink rapidly.

F. Contactors in starters shall be general purpose NEMA rated for connected H.P. (definite purpose starters not acceptable). Coordinate control voltage with Controls Contractor. Provide auxiliary contacts where required for interlocking of electrical equipment. Provide 2-speed motor starters where indicated or required.

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G. Single phase motors shall have one of the following factory wired methods of n
   1. Integral thermal overload protection in motor and cord with plug and rec
      casing.
   2. Integral thermal overload protection in motor and disconnecting switch n
      casing as specified with equipment.
   3. Switch with thermal overload protection for unprotected motors with swi
      disconnect device.

H. For starters associated with equipment that is required to be shut down upon a fire alarm condition, provide input contacts within the starter enclosure to interface with the building's fire alarm system. Upon receipt of a signal from the building's fire alarm system, power to load side of the starter shall be turned off. Circuitry shall be provided to ensure that power is off whether the starter is in the "AUTO", "HAND" or "BYPASS" mode. If this feature is not available from the starter manufacturer, provide a contactor on the line side of the starter to accomplish the same function. The contactor shall meet the requirements of Division 26.

2.3 V-BELT DRIVES

A. Provide self-aligning roller-bearings mounted in sealed housings with grease fittings and grease overflow valves. Fan wheels and shafts shall be designed for critical speed at least 20 percent higher than the maximum fan speed. The assembled fan shall be statically and dynamically balanced at the factory. Bearings shall be certified to have an average life per AFBMA of not less than 200,000 hours.

B. The drive base shall be constructed to allow adjustment of belt tension without having to loosen motor hold-down bolts.

C. Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
   1. Provide adjustable-sheave belt drives for motors, except as otherwise specified in individual Sections of the Specifications.
   2. Sheaves on motors 25 hp (18.6 kW) and over shall be fixed type.

2.4 VARIABLE FREQUENCY DRIVES

A. Acceptable Manufacturers:
   1. ABB (ACH550 Series) (basis of design).
   2. Cerus Industrial, Inc. (P-Series).
   3. Danfoss (VLT FC-100 Series).
   4. Rockwell Automation (Allen-Bradley).
   5. Toshiba (Q7 Series).
   6. Yaskawa (E7 Series).
   7. No substitutions.

B. The variable frequency drives (VFDs) with options shall be UL listed as a complete assembly and shall be built in compliance with the latest standards of ANSI, IEEE, NEMA and the National Electric Code.

C. The VFDs shall be designed to meet the requirements of the following standards: IEC801-2, IEC801-4, IEC255-4.

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D. Quality Assurance:
   1. Manufacturer: Shall specialize in manufacture, assembly, and field perfc VFDs with minimum 5 years' experience.
   2. The VFD manufacturer shall have an existing representative, exclusively applications, an independent service and start-up organization, and a part local to the installation.

E. Warranty and Start-Up Service:
   1. Start-Up Service: The VFD manufacturer shall provide a start-up service package. Service shall include inspection, final adjustment, operational checks, coordination with interface to building's ATC system (coordinate with Division 23 Section "Instrumentation and Controls for HVAC") and a final report for record purpose. Start-up service shall be performed by a factory approved and certified technician.
   2. Report: Submit a report of start-up and initial settings and readings.
   3. Owner Training: Provide a session of at least 4 hours, to train 2 or more of the Owner's representatives in the operation and maintenance of the drives. Schedule the training at the Owner's convenience within normal working hours, within 2 months after Substantial Completion.
   4. Warranty: For a period of 2 years after factory start-up, the VFD manufacturer shall include a full parts and labor on-site warranty at no additional cost.

F. Construction:
   1. Pulse Width Modulated design converting the fixed utility voltage and frequency to a variable voltage and frequency output. The VFD shall employ a full wave bridge rectifier, DC bus choke, DC bus filter capacitors, and Insulated Gate Bipolar Transistors (IGBTs) as the output switching device. SCRs, GTOs and Darlington transistors are not acceptable. The drive efficiency shall be 97 percent or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.
   2. 6-pulse (minimum) converter section.
   3. NEMA 1 ABS plastic or metal enclosure.
   4. Standard operating conditions are:
      a. Incoming AC power at building power system design's phase and voltage (see Contract Drawings) ±10 percent, 60 Hz. Output voltage, phase and frequencies compatible with equipment served (see Contract Drawings).
      b. Humidity 0 to 95 percent (noncondensing and noncorrosive).
      c. Altitude 0 to 3,300 feet above sea level, without derating.
      d. Ambient temperature 0 to 40 degrees C.
      e. Verify actual operating conditions, and derate drive capacity as required.
   5. VFDs shall include the following features:
      a. Customer interface, including digital display in plain English (code numbers are not acceptable), keypad and customer connections.
      b. Carrier (Switching) Frequency: Optimized for a 3 kHz or 4 kHz carrier frequency to reduce motor noise. The carrier frequency shall be adjustable by the start-up technician, in a range at least as low as 1 kHz and as high as 8 kHz. Provide at least the following settings to allow fine tuning: 1 kHz, 4 kHz, and 8 kHz.
      c. Built-in program to automatically vary the carrier (switching) frequency. Acceptable types of control include:
         1) ABB's switching frequency foldback control, reduces heat generated by the IGBTs by reducing the carrier frequency if the heatsink temperature rises above 176-194 degrees F (80-90 degrees C).

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2) Danfoss automatic switching frequency modulation, reduces loads (below 60 percent) by adjusting the carrier frequency maximum, and provides maximum power and efficiency at adjusting the carrier frequency downward to a more efficien

d. The option of either (1) displaying a fault, (2) running at a preset s running at the last known speed (average of last 10 seconds) if the (4-20mA or 2-10V) is lost.

e. Automatic restart after an overcurrent, overvoltage, or undervoltage, or loss of input signal protective trip. The number of restart attempts and trial time shall be programmable.

f. The ability to start into a rotating load (forward or reverse) and accelerate or decelerate without safety tripping or component damage (flying start).

g. Automatic power loss ride through circuit that will utilize the inertia of the load to keep the drive powered. Minimum power loss ride through shall be 1 cycle based on full load and no inertia.

h. Isolated power for control circuits.

i. Input line fuses.

j. Acceptable start/stop commands shall include closure of a contact or switch, application and removal of input power and optional application and removal of 115 VAC on-off signal.

k. Load loss detection. Each VFD shall provide a dry contact closure at a field adjustable load threshold to indicate a loss of motor load (for example, broken fan belt or pump cavitation).

l. Pilot light cluster to provide visual indication of protective functions and circuit status, including the following LEDs:
   1) Power on (Red): Illuminates when main power is applied to the controller.
   2) AFC Run (Green): Illuminates to annunciate a drive run condition.
   3) AFC Fault (Yellow): Illuminates to annunciate a fault condition.

m. Five programmable critical frequency lockout ranges to prevent the VFD from continuously operating at an unstable speed.

n. PI setpoint controller integral to the drive, allowing a pressure or flow signal to be connected to the VFD, using the VFD for the closed loop control, eliminating the need for external controllers.

o. Three programmable digital relay outputs, rated for maximum switching current 8 amps at 24 VDC and 0.4 amps at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS.

p. Seven programmable preset speeds.

q. Six programmable digital inputs for interface with energy management system.

r. Two independently adjustable acceleration and deceleration ramps, adjustable from 1 to 1800 seconds.

s. Ramp or coast to a stop.

t. Two programmable analog outputs to provide 4-20 ma signals linear to output frequency, motor speed, output current, motor torque, motor power, DC bus voltage, and motor voltage.

6. VFD door mounted operator digital display shall include:
   a. Output Frequency
   b. Motor Speed (RPM)
   c. Motor Current
   d. Calculated Motor Torque
   e. Calculated Motor Power
   f. DC Bus Voltage

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g. Output Voltage
h. Heat Sink Temperature
i. Analog Input Values
j. Keypad Reference Values
k. Elapsed Time Meter

7. VFD speed command input shall include:
   a. Keypad.
   b. Two analog inputs, each capable of accepting a 0-20 mA, 4-20mA, 0-10V, and 2-10V signal inputs isolated from ground, and programmable via the keypad for different uses. Inputs shall have a programmable filter to remove any oscillation of the reference signal. The filter shall be adjustable from 0.01 to 10 seconds. The input shall be able to be inverted, so that minimum reference corresponds to maximum speed, and maximum reference corresponds to minimum speed.
   c. Floating point input to accept a three wire input from a Dwyer Photohelic gauge or equivalent type instrument.
   d. RS-485 communications.
8. The VFD shall include the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in plain words.
   a. Overcurrent trip, 200 percent of the VFD's variable torque current rating.
   b. Overvoltage trip, 130 percent of the VFD's rated voltage.
   c. Undervoltage trip, 60 percent of the VFD's rated voltage.
   d. Over temperature, + 70 degrees C.
   e. Ground fault.
   f. Adaptable Electronic Motor Overload Protection: Shall protect the motor based on speed, load curve, and external fan parameter. Circuits that protect the motor only at full speed are unacceptable.
   g. Power line surge protection by means of a metal oxide varistor (m.o.v.).
9. Accessories to be furnished and mounted by the drive manufacturer and contained in a single enclosure (the use of more than one enclosure is not acceptable):
   a. Protection From Harmonics and Voltage Spikes: Provide one of the following:
      1) Line Reactors: 3-percent AC input line reactors to reduce harmonic current distortion to the incoming power line, and to provide some protection to the drive from incoming voltage spikes. Provide reactors in each phase of incoming power to each VFD. Install between the input power and the drive's input bridge rectifier (so they protect the rectifier). The line reactor shall provide attenuation of line side voltage transients, thus preventing overvoltage trips or other unnecessary VFD shutdowns and providing a reduction in harmonic current distortion. Line reactors shall be manufactured by TCI of Milwaukee, WI and must meet the following requirements: provide a minimum of 2-1/2 percent line impedance, have a saturation rating of no less than 2.5 times the continuous current rating, and be UL recognized.
      2) ABB Design: Integral 5 percent swinging chokes in the AC input lines, configured between the input power and the drive's input bridge rectifier (so they protect the rectifier from spikes in input power).
         a) The swinging choke is an inductor with an inductance value inversely proportional to its operating current. Over a substantial portion of the normal operating current range, the inductance decreases as the current in the choke increases. A conventional or linear choke has a fixed inductance value that changes very little as the operating current varies in the normal operating range.

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b) The harmonic limiting effectiveness of the swinging c
when the operating point is less than maximum powe
c) Compared to a standard linear choke, the swinging ch
superior line harmonic current reduction when the dri
power is less than or equal to rated output.
d) The effective inductance value of a swinging choke a
higher than the value of a linear choke of the same physical size.
e) The efficiency of a swinging choke is higher than the efficiency of a linear choke of the same inductance value.
f) Since the design point BHP is nearly always less than the nameplate horsepower of the selected motor, with swinging chokes the harmonic contribution of the drive will nearly always be less than that at maximum rated output power.
g) See U.S. Patent No. 6,774,758, "Low harmonic rectifier circuit" using non-linear inductor(s).

3) Danfoss Design: Harmonic suppression and surge suppression integral to the drive using separate components.
   a) Harmonic Suppression: DC link chokes (inductors) installed between the drive's input bridge rectifier and the inverter bus capacitor, consisting of a dual, 5 percent DC-link reactor on the positive and negative rails of the DC bus. This reactor reduces the level of harmonics reflected back into the building power system without causing a voltage loss at the drive's input, and improves input power factor. The reactor is non-saturating (linear) to provide full harmonic filtering throughout the entire load range. In performance, the harmonic suppression of the DC-link reactor is equivalent to a 5 percent AC line reactor.
   b) Incoming Power-Line Surge Suppression: Fast-acting Metal Oxide Varistor (or (MOV) installed between the input power and the drive's input bridge rectifier, Zener diodes and oversized DC bus capacitors to provide protection against high potential spikes. When the voltage exceeds 2.3 times the expected incoming voltage for 1.3 milliseconds, the MOV shorts, protecting the internal parts of the drive including the 3-phase full-wave diode bridge. The reactor also acts to reduce input current caused by power line disturbances. Provide 4 MOVs, one on each of the 3 inputs and one attached to the DC Link. Comply with the German specification for surge suppression (VDE 0160).
4) Linear chokes or DC link chokes used alone without surge suppression on the incoming power are NOT acceptable as alternatives to line reactors. If they are standard and integral to the VFD, they may be provided in addition to line reactors.

b. Bypass: Manual transfer to line power via contactors and including class 20 bimetal motor thermal overload relays and fuse or circuit breaker protection while in bypass operation, with automatic bypass capability.
   1) Provide bypass on drives which serve single non-redundant motors, such as fan motors in air handling units and air conditioning units.
   2) Bypass is not required on drives which serve one of a pair of matching and fully-redundant motors with individual drive per motor (such as a pair of pumps where one is the lead pump and one is a 100 percent backup, and each pump has its own VFD).

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c. Service switch which provides the ability to service the controller isolated while in bypass operation) without having to remove pow
d. Hand-off automatic switch (HOA), prewired. The HOA switch sh in both the Normal and Bypass (if provided) modes of operation. be dial type, or momentary-contact pushbutton type with LED indi The switch may be integral to the standard VFD keypad, if it is a d physical switch that is always available, but it is not allowed to serve any other functions, and it may not be a virtual switch such as on a touchscreen.
    1) When Auto mode is selected, the external start command and external reference speed signal shall control the motor.
    2) When Hand mode is selected, the motor shall run and the manual potentiometer shall control the motor speed. Other controls and inputs/outputs shall function as in Auto mode.
e. Manual potentiometer, dial type with calibrated nameplate. Provide an analog (dial-type) or digital meter to indicate selected speed.
    1) If the HOA switch is a dedicated button integral to the VFD keypad, and the potentiometer function is immediately available without any further steps when the HOA is in "Hand" position (such as up-down pushbuttons on the face of the keypad), the potentiometer may be integral to the standard VFD keypad. The speed meter may be a display on the general display screen.
f. Customer Interlock Terminal Strip - provide a separate terminal strip for connection of fire, smoke, freeze contacts and external start command. External interlocks and start/stop contacts shall function with drive in hand, auto or bypass.
g. Door interlocked disconnect or circuit breaker, padlockable in off position.
h. For drives that control fans or pumps which are specified to operate in an automatic lead/lag arrangement, provide automatic alternation device in VFD enclosure. (coordinate with Division 23 Section "Instrumentation and Controls for Mechanical Systems").

10. Energy Management System Interface
    a. Drive shall have the capability to be controlled and monitored via analog and digital inputs and outputs.
    b. In addition to analog and digital I/O the VFD shall be capable of communicating with the following controls companies' communication buses with no extra hardware:
        1) Johnson Controls
        2) Siemens Controls
    c. Drive shall have integral capability to be controlled and monitored through BACnet, LonWorks, Modbus, or other serial communication protocol compatible with the building automatic temperature control system. Provide adapter modules as required.
    d. Coordinate with suppliers and installers of building automatic temperature control system to ensure compatibility and full functionality. See Division 23 Section "Instrumentation and Controls for Mechanical Systems."
11. In the event of a power failure and upon restoration of power, the variable frequency drive shall remain responsive to its command signal from the building's energy management/temperature control system. The drive shall not require manual resetting after a power outage in order to respond to the energy management/temperature control system's command signal.
12. For drives that are associated with equipment that is required to be shut down upon a fire alarm condition, provide input contacts within the VFD enclosure to interface with the building's fire alarm system. Upon receipt of a signal from the building's fire alarm

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system, power to load side of the VFD shall be turned off. Circuitry shal ensure that power is off whether the VFD is in the "AUTO", "HAND" or mode. If this feature is not available from the VFD manufacturer, provid the line side of the VFD to accomplish the same function. The contactor requirements of the Electrical Division of the Specifications.

13. Occasional input and output power circuit switching shall be able to be a without interlocks or damage to the drive. If drive design cannot tolerate interruption of output, such as by a disconnect switch mounted between the drive and the motor, provide protective devices and coordinate with installers to protect the drive as specified in Part 3 – Execution in this Section.

G. Compliance with IEEE-519:
   1. Input Line Reactors: Provide as specified in "Construction" paragraph of this Section.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Division 01 Section "Quality Requirements": Manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Coordinate with Division 26 "Electrical."

D. Check line voltage and phase and direction of rotation, and ensure agreement with nameplate.

E. Install guards in accordance with Codes and OSHA requirements.

F. Adjust motor overload devices based on motor amperage ratings and field measurements of running amps, to ensure protection of the motor and eliminate nuisance trips.

G. Disconnect Switch Mounting Height: Install at height above finished floor in accordance with NFPA 70.
   1. In most instances, the center of the grip of the disconnect switch operating handle in its highest position shall be no more than 79 inches (2.0 m) above finished floor or working platform.
   2. Switches and circuit breakers installed adjacent to the equipment served (and within 79 inches (2.0 m) above finished floor or working platform.

H. Variable Frequency Drives:
   1. Mounting Height:
      a. Install with the disconnect switch height in accordance with NFPA 70, as described in the paragraph "Disconnect Switch Mounting Height" in this Section.
      b. The VFD shall be considered to be a piece of equipment served by its disconnect switch, for purposes of NFPA 70, unless otherwise indicated, or otherwise directed by the Authority Having Jurisdiction or by the Owner.
         1) If the motor served by the VFD is within sight of the VFD, and within 50 feet (15.2 m) measured in a straight line, this disconnect switch may also serve the motor unless otherwise indicated.

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c. When possible, install VFDs with their operator-interface display a
(2.0 m) or less above finished floor, unless otherwise indicated or
1) To restrict unauthorized access, VFDs in locations accessibl
(such as but not limited to classrooms, unrestricted storage r
corridors) shall be mounted with the disconnect switch at 72
(1.8 to 2.0 m) above finished floor, with the VFD operator d
accessories mounted above the disconnect switch, where ceiling height allows, unless otherwise indicated.
2) In mechanical rooms and other restricted-access locations, mount VFDs at a height for greatest user convenience.

d. When possible, mount groups of adjacent VFDs with tops at uniform height above finished floor.

e. Because VFDs produce heat, do not install a VFD above another one, or above another heat-producing device. Do not install a VFD below or too near to any heat-sensitive device or room temperature sensor. Provide ventilation space and other means of cooling as required by the manufacturer.

f. Install with service and installation clearances as required by the manufacturer.

2. Electrical Connections:

a. Provide separate metal conduits for drive input power, output power to the motor, and control wiring. Output motor cables from multiple drives shall be run separately.

b. Ground each drive separately.

c. Ensure that a fused disconnect switch is provided upstream between the transformer and the drive. Fuses are required because they are faster-acting than circuit breakers.

d. If drive design cannot tolerate interruption of output, such as by a disconnect switch mounted between the drive and the motor, provide protective devices and coordinate with installers to protect the drive, and coordinate with installers to ensure that no unnecessary switching is installed.

1) When the VFD is out of sight from the equipment served, or is more than 50 feet (15.2 m) from the equipment served, a disconnect switch mounted on or adjacent to the equipment is generally required in Division 26 “Electrical” or by the Authority Having Jurisdiction. If such a disconnect or other switching device is indicated or required, provide protective devices as required by the VFD manufacturer. Such devices typically include an “early-break” auxiliary set of contacts or a “Stop” button on the disconnect switch, field-wired to the VFD’s external fault input or stop input, so that if the switch is opened while the VFD is running, the input will shut off the output of the VFD. The VFD stop method must be set to “Coast.” Provide field wiring in conduit.

2) Provide engraved nameplates at disconnect switches and other devices, instructing users on the proper operation of these devices to prevent damage to the VFD.

3. Carrier Frequency: Adjust to minimize noise, but also to minimize the potential for motor bearing damage due to VFD-induced shaft voltage.

a. VFDs convert line AC voltage to a pulse width modulated (PWM) AC voltage of variable frequency. The switching frequency of these pulses is referred to as the “carrier frequency.” The switching induces a voltage on the rotor shaft, which, if it builds up to a sufficient level, can discharge as “bearing current” to ground through the bearings. This has an electric discharge machining (EDM) effect, causing

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pitting of the bearing's rolling elements and raceways. This effect
minimized by proper setup.

b. The higher the carrier frequency, the higher the rate of the current
pulses, and the more likely EDM will occur. At higher carrier frec
VFD will generally run quieter; however, it becomes more destruc
motor insulation and bearings.

c. Adjust the carrier frequency as low as possible without creating unacceptable audible noise levels, and to avoid frequencies above 6 kHz altogether if possible.

4. Coordinate with building controls systems as specified in Part 2 of this Section.
5. Perform startup service, and submit report.
6. Provide warranty service.
7. Provide Owner training.

END OF SECTION 230513

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SECTION 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPM

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PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and equipment hangers and supports.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing and sealing equipment and pipe stacks.

1.2 RELATED SECTIONS

A. Division 03 Section "Cast-In-Place Concrete": Equipment bases.

B. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Division 23 Section "HVAC Piping Insulation."

D. Division 23 Section "HVAC Equipment Insulation."

E. Division 23 Section "Hydronic Piping."

1.3 REFERENCES

A. ASME B31.1 - Power Piping.

B. ASME B31.2 - Fuel Gas Piping.

C. ASME B31.5 - Refrigeration Piping.

D. ASME B31.9 - Building Services Piping.

E. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

F. ASTM A653 G90 SS Gr. 33 - Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot Dipped Process.

G. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

H. ASTM C531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts, Monolithic Surfaces, and Polymer Concretes.

I. ASTM C642 - Test Method for Specific Gravity, Absorption, and Voids in Hardened Concrete.

J. ASTM C672 - Test Methods for Scaling Resistance of Concrete Surfaces Exposed to Deicing

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Chemicals.

K. ASTM D395 - Standard Test Methods for Rubber Property - Compression Set.

L. ASTM D412 - Test Methods for Vulcanized Rubber and Thermoplastic Elastor

M. ASTM D573 - Test Method for Rubber - Deterioration in an Air Oven.

N. ASTM D746 - Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

O. ASTM D2240 - Test Method for Rubber Property - Durometer Hardness.

P. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

Q. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

R. MSS SP69 - Pipe Hangers and Supports - Selection and Application.

S. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

T. NFPA 70 - National Electrical Code

1.4 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures”.

B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

C. Product Data: Provide manufacturers catalog data including load capacity.

D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years’ experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable Codes for support of piping.

B. Supports for Electrical: In conformance with NFPA 70 and Division 26 of the Specifications.

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PART 2 - PRODUCTS

2.1 HANGERS, SUPPORTS, & PIPE CLAMPS

A. Approved Manufacturers (first manufacturer is basis of design):
   1. Strut Hangers:
      a. Unistrut (division of Tyco).
      b. Anvil International.
      c. Cooper B-Line.
      d. Hydra-Zorb Company.
      e. Thomas & Betts - Superstrut line.
      f. Tolco (division of Cooper B-Line).
   2. Adjustable Swivel Band Hangers:
      a. Carpenter & Paterson.
      b. Anvil International.
      c. Cooper B-Line.
      d. Tolco (division of Cooper B-Line).
   3. Clevis Hangers:
      a. Cooper B-Line.
      b. Anvil International.
      c. Carpenter & Paterson.
      d. Tolco (division of Cooper B-Line).
   4. J-Hangers:
      a. Cooper B-Line.
      b. Carpenter & Paterson.
      c. Thomas & Betts - Superstrut line.
      d. Tolco (division of Cooper B-Line).
      e. Unistrut (division of Tyco).
   5. Cushion Clamps:
      a. Hydra-Zorb Company.
      b. Cooper B-Line.
      c. Thomas & Betts - Superstrut line.
      d. Tolco (division of Cooper B-Line).
      e. Unistrut (division of Tyco).
   6. Insulated Pipe Couplings:
      a. Cooper B-Line - Armafix line.
      b. Klo-Shure Corporation.
   7. No substitutions.

B. Horizontal Piping Supports: Provide struts for trapeze hangers for single or multiple pipes. Where individual piping runs are hung with individual hangers, adjustable swivel band hangers, clevis hangers, or j-hangers may be used.

C. Strut hangers shall be standard 1-5/8 inches x 1-5/8 inches (41x41 mm) size.

D. Hangers, clamps, and supports located outdoors or otherwise exposed to weather, or in wet or washdown areas, shall be hot-dipped galvanized steel or 300-series stainless steel. Struts may be extruded aluminum. Threaded rods, nuts, and washers may have standard galvanizing if hot-dipped galvanized is not available.
   1. Hot-dipped galvanized steel shall have a nominal zinc coating of 2.6 mil (0.066 mm)

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thickness and 1.5 oz./sq.ft (458 g/m^2) coating weight.

2. In lieu of galvanizing, strut systems and their accessories may have Unist Green III electrodeposited thermoset acrylic coating, or be epoxy-coated Line's Dura-Green or Dura-Copper coatings.
3. Lesser coatings for struts and clamps, such as pre-galvanizing (0.75 mil (thickness), electroplated zinc (0.2 to 0.5 mil (0.005 to 0.013 mm) thickne zinc dichromate coating, are not acceptable in these locations.

E. Pipe hanger rods and nuts shall be plated to match the hangers. Nuts shall be self-locking type, or provide double nuts tightened to lock together. Rods shall be threaded one end, or continuous threaded. Provide washers at each nut.

F. Cushion Clamps for Un-insulated Lines: Plastic cushion shall be Dupont Hytel plastic, 5555HS plastic elastomer, warranted from -40 to 275 degrees F (-40 to 135 degrees C).

G. Copper-plated hangers are plated for identification only. Traditional thin copper plating on steel substrate does not provide adequate protection from galvanic corrosion due to contact between dissimilar metals.
   1. Where copper-plated supports are specified for use with copper piping, either copper plating or a copper-colored finish such as Cooper B-Line's Dura-Copper epoxy coating is acceptable. This is for identification, and does not protect dissimilar metals.
   2. Where copper piping is used with steel hangers and supports, provide protection from galvanic corrosion such as thick plastic or vinyl factory coating, or plastic-lined cushion clamps.

H. For Insulated Lines Clamped to Strut: Insulated pipe coupling insert with the same thickness as the insulation. Protects insulation from crushing, and provides continuous insulation and vapor barrier thru the hanger or clamp. Klo-Shure product provides plastic pipe support and rigid outer band, for field insulation into the coupling. Armafix product provides insulation with rigid outer band, for field insulation glued to the ends of the insert.

2.2 PIPE SUPPORTS

A. Hydronic Piping:
   1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
   2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
   3. Hangers for Cold Pipe Sizes 2 inches (50 mm) and Over: Carbon steel, adjustable, clevis.
   4. Hangers for Hot Pipe Sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis.
   5. Hangers for Hot Pipe Sizes 5 inches (125 mm) and Over: Adjustable steel yoke, cast iron roll, double hanger.
   6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches (150 mm) and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
   8. Wall Support for Pipe Sizes to 3 inches (76 mm): Cast iron hook.
   9. Wall Support for Cold Pipe Sizes 4 inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
   10. Wall Support for Hot Pipe Sizes 4 inches (100 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

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11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, n flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes to 4 inches (100 mm): Cast iron adjusta lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 5 inches (125 mm) and Over: Adjustab and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

B. Refrigerant Piping:
1. Conform to ASME B31.5, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches (50 mm) and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 inches (75 mm): Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.3 INSERTS

A. Manufacturers:
1. Cooper B-Line.
2. Grinnell.

B. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. Metal Flashing: 26 ga (0.5 mm) thick galvanized steel.

B. Metal Counterflashing: 22 ga (0.8 mm) thick galvanized steel.

C. Lead Flashing:
1. Waterproofing: 5 lb/sq ft (24.5 kg/sq m) sheet lead
2. Soundproofing: 1 lb/sq ft (5 kg/sq m) sheet lead.

D. Flexible Flashing: 47 mil (1.2 mm) thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 ga (0.8 mm) minimum; 16 ga (1.5 mm) at fire resistant elements.

2.5 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 ga (1.2 mm) thick galvanized steel.

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B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potenti
Steel pipe or 18 ga (1.2 mm) thick galvanized steel.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and
Prefabricated fire rated sleeves including seals, UL listed.

D. Sleeves for Round Ductwork: Galvanized steel.

E. Sleeves for Rectangular Ductwork: Galvanized steel.

F. Stuffing or Firestopping Insulation: Glass fiber type, non-combustible.

G. Sealant: Acrylic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.

C. Place hangers within 12 inches (300 mm) of each horizontal elbow.

D. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet (1.5 m) maximum spacing between hangers.

F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated hangers and supports for copper piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Prime coat exposed steel hangers and supports. Refer to Division 09 Section “Painting”. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

L. Do not support pipes from other pipes or equipment.

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M. Size pipe hangers to accommodate continuous piping insulation.

3.3 EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4 inches (100 mm) thick and inches (150 mm) beyond supported equipment, with 1 inch (25 mm) chamfered dowels to fasten pad to structural floor. Refer to Division 03. Unless otherwise shown or specified, floor-mounted major equipment shall be set on housekeeping pads and anchored to housekeeping pads. This shall include but not be limited to, air handling units, utility set fans, compressors, base mounted pumps, boilers, converters, heat exchangers, storage tanks and expansion tanks.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

E. Do not support equipment from pipes or from other equipment.

3.4 FLASHING

A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weatherproofed or waterproofed walls, floors, and roofs.

B. Flash pipes projecting 3 inches (75 mm) minimum above finished roof surface with lead, 8 inches (200 mm) minimum clear on sides with 24 x 24 inches (600 x 600 mm) sheet size. For pipes through outside walls, turn flanges back into wall and caulk, counterflash with metal, and seal.

C. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

D. Provide curbs for mechanical roof installations 14 inches (350 mm) minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.5 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors 1 inch (25 mm) above finished floor level. Caulk sleeves.

D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or

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duct and adjacent work with fire stopping insulation and caulk air tight. Provid metal collar or escutcheon covers at both sides of penetration.

E. Install chrome plated steel escutcheons at finished surfaces.

3.6 SUPPORTING OTHER TRADES

A. Supports furnished under Division 23 of the Specifications may also be used to support piping furnished under Division 22 "Plumbing" and conduits furnished under Division 26 "Electrical" if this Subcontractor is willing to allow this. Supports shared with other trades shall be designed to accommodate the weight, expansion/contraction, vibration, and other requirements of the other trades' items without detriment to the function, accessibility, and serviceability of the HVAC items or those of the other trades. Provide flexible sections of piping and conduit as required to allow each trade's items to expand and contract along with the other trades, and to absorb vibration caused by the other trades.

B. Electrical lighting fixtures and equipment, and architectural items such as ceilings, may not be supported from supports furnished under this Section.

C. Prevent contact between components of other trades, such as architectural suspended ceiling support wires, and HVAC supports which may transmit vibration to the occupied space.

3.7 SCHEDULES

PIPE SIZE		HANGER ROD MAX. HANGER SPACING		DIAMETER	
Inches	(mm)	Feet	(m)	Inches	(mm)
Steel and Copper Piping					
1/2 to 1-1/4	12 to 32	6.5	2	3/8	9
1-1/2 to 2	38 to 50	10	3	3/8	9
2-1/2 to 3	62 to 75	10	3	1/2	13
4 to 6	100 to 150	10	3	5/8	15

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SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Labels.

D. Pipe Markers.

1.2 RELATED SECTIONS

A. Division 09 Section "Painting": Identification painting.

1.3 REFERENCES

A. Division 01 Section "References": Requirements for references and standards.

B. ASME A13.1 - Scheme for the Identification of Piping Systems (2007 edition or newer).

C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

D. NFPA 99 - Standard for Health Care Facilities.

1.4 SUBMITTALS

A. Division 01 Section "Submittal Procedures."

B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Samples: Submit 2 tags, 1-1/2 inches (38 mm) in size.

F. Samples: Submit 2 labels, 1.9 x 0.75 inches (48 x 19 mm) in size.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under Division 01 Section "Closeout Procedures."

B. Record actual locations of tagged valves; include valve tag numbers.

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1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section "Operation and Maintenance D

B. Include valve tag chart.

1.7 REGULATORY REQUIREMENTS

A. Conform to NFPA 99 requirements for labeling and identification of medical gas piping systems and accessories.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:
   1. Seton Identification Products.
   2. E.R. Perry Signs & Engraving.
   3. Brimar Industries, Inc., PipeMarker division.
   4. No substitutions.

B. Plastic Nameplates: Laminated 3-layer plastic with beveled edges and engraved letters on contrasting background color, 1/16 inch (1.58 mm) thick. Letters shall be black on light backgrounds, or white on dark backgrounds, as applicable. Service temperature range -40 to 175 degrees F (-40 to 79 degrees C); minimum application temperature for adhesive 50 degrees F (10 degrees C). Suitable for average outdoor lifespan of at least 2-3 years.

C. Aluminum Nameplates: For higher temperature applications, and for outdoor applications when manufacturer does not recommend their plastic nameplates for use outdoors, provide aluminum nameplates, with integral anodized or painted surface color coating and natural aluminum engraved letters, 1/32-inch (0.78 mm) thick. Service temperature range -40 to 350 degrees F (-40 to 177 degrees C); minimum application temperature for adhesive 50 degrees F (10 degrees C). Suitable for average outdoor lifespan of at least 2-3 years.

D. Colors: Select background color as appropriate for the application. Color for general applications shall be white (except that aluminum nameplate standard color shall be black). Color for general warnings shall be red or yellow. Colors for fluid services shall comply with ASME A13.1-2007. Comply with ASME/ANSI standards and other regulations as applicable.

E. Provide with factory adhesive, and with side holes for fastener attachment as applicable. Mechanical fasteners are required for applications which are outdoors or otherwise exposed to weather or sunlight, or in moist areas such as kitchens and locker rooms, or on cooled surfaces subject to condensation, or on surfaces with operating temperatures above 150 degrees F (65 degrees C). Where nameplate is on an irregular surface and cannot make complete contact, provide mechanical fasteners or ties in addition to adhesive.

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2.2 TAGS

A. Plastic Tags:
1. Manufacturers:
a. Seton Identification Products.
b. E.R. Perry Signs & Engraving.
c. Brimar Industries, Inc., PipeMarker division.
d. No substitutions.
2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches (38 mm) diameter.

B. Metal Tags:
1. Manufacturers:
a. Seton Identification Products.
b. Brady Worldwide, Inc.
c. Brimar Industries, Inc., PipeMarker division.
d. No substitutions.
2. Brass with stamped letters; tag size minimum 1-1/2 inches (38 mm) diameter with smooth edges.

C. Information Tags:
1. Manufacturer: Seton Identification Products.
2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches (83 x 143 mm) with grommet and self-locking nylon ties.

D. Tag Chains and Hooks: Brass or stainless steel compatible with tag material for general applications. Brass where in contact with copper piping or other copper-alloy materials.

E. Tag Chart: Typewritten letter size list in anodized aluminum frame with plexiglass cover.

2.3 LABELS

A. Manufacturer: Seton Identification Products.

B. Description: Polyester, size 1.9 x 0.75 inches (48 x 19 mm), adhesive backed with printed identification.

2.4 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Pipe Markers:
1. Manufacturers:
a. Seton Identification Products.
b. Brady Worldwide, Inc.
c. Brimar Industries, Inc., PipeMarker division.
d. No substitutions.
2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

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C. Plastic Underground Pipe Markers:
   1. Manufacturers:
      a. Seton Identification Products.
      b. Brady Worldwide, Inc.
      c. Brimar Industries, Inc., PipeMarker division.
      d. No substitutions.
   2. Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Division 09 Section “Painting” for stencil painting.

3.2 INSTALLATION

A. Division 01 Section “Quality Requirements”: Manufacturer's instructions.

B. Install identifying devices after completion of coverings and painting.

C. Install plastic or aluminum engraved nameplates with corrosion-resistant mechanical fasteners, or adhesive, as specified. In outdoor locations, where lifetime of nameplates is limited, fasteners shall be removable screws or bolts for ease of nameplate replacement.

D. Install labels with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

E. Install tags using corrosion resistant chain. Number tags consecutively by location.

F. Identify items of mechanical equipment such as chillers, fans, terminal units, air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Identify valves in main and branch piping with metal tags.

I. Tag automatic controls, instruments, and relays. Key to control schematic.

J. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch (20 mm) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m)on straight runs including risers and drops, at each branch and riser take-off, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

K. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

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L. Identify duct access doors at fire dampers, smoke dampers, and smoke detectors (12.7 mm) lettering to indicate the fire protection device(s) within, in accordanc NFPA 90A.

M. Provide [ceiling dots with label-maker labels] [ceiling tacks] to locate valves, d equipment above T-bar type panel ceilings. Locate in corner of panel closest to

N. Secure valve tag chart on an easily accessible wall in the mechanical room or in a location as otherwise directed by the Architect.

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SECTION 230593 – TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Testing, Adjustment, and Balancing of Air Systems.

B. Testing, Adjustment, and Balancing of Hydronic Systems.

C. Measurement of Final Operating Condition of HVAC Systems.

1.2 RELATED SECTIONS

A. Division 01 Section "Quality Requirements": Testing laboratory services: Employment of testing agency and payment for services.

B. Division 01 Section "General Commissioning Requirements."

1.3 REFERENCES

A. AABC - National Standards for Total System Balance.

B. ADC - Test Code for Grilles, Registers, and Diffusers.

C. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.

D. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

E. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.4 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers.

C. NEBB: National Environmental Balancing Bureau.

D. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

E. TAB: Testing, Adjusting, and Balancing.

1.5 SUBMITTALS

A. Submit under provisions of Division 01 Section "Submittal Procedures."

B. Submit name of TAB Agency for approval within 30 days after award of Contract.

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C. Design Review Reports:
   1. Submit prior to commencement of construction under provisions of Divi "Quality Requirements."
   2. Review the Contract Documents, and indicate deficiencies in systems tha proper testing, adjusting, and balancing of systems and equipment to ach performance.

D. Preliminary Report Submittals:
   1. Prior to commencing work of this Section, and no more than 30 days after approval of TAB Agency submittals, submit report forms or outlines indicating adjusting, balancing, and equipment data required, with columns of design data filled in. By means of plan views, equipment profiles, and similar graphical descriptions, indicate where measurements will be taken.
   2. Submit the procedures to be used.

E. Field Reports: Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

F. Provide reports in letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

G. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.

H. Test Reports: Indicate data on AABC National Standards for Total System Balance forms, or forms prepared following ASHRAE 111, or NEBB forms, or forms containing information indicated in Schedules.

1.6 QUALITY ASSURANCE

A. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance; or ASHRAE 111; or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.7 QUALIFICATIONS

Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum 3 years' experience and certified by AABC or NEBB, or equivalent experience which would qualify for membership in these testing organizations. Agency shall be one of those listed under article 3.1 AGENCIES in this Section

A. Perform Work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, or registered Professional Engineer experienced in performance of this Work and licensed at the place where the Project is located

1.8 SEQUENCING

A. Sequence work under the provisions of Division 01 Section "Summary."

B. Sequence work to commence after completion of systems or portions of work, a
completion of work before Substantial Completion of Project.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 AGENCIES

A. Tekon Technical Consultants, Rochester, NH. Contact: Charles Corlin, (603) 335-3080.

B. Maine Air Balance, Brewer, ME. Tel. (207) 989-0533.

C. Whitetail Air Balance LLC, Lisbon, ME. Contact: Jim Davis, (207) 577-9292.

D. Air Solutions, Auburn, NH, Contact: Jeremy Reid, (603) 262-9292

E. TAB-TECH International, Albion, ME. Contact: Daniel Althenn, 207-437-4400.

F. No Substitutions.

3.2 EXAMINATION

A. Verify that systems are complete and operating correctly in accordance with sequence of operations before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

B. Submit field reports. Report to the responsible Subcontractors, defects and deficiencies noted during performance of services which prevent system balance. Submit list of locations where the Contractor needs to provide additional balancing devices.

C. Beginning of work means acceptance of existing conditions.

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3.3 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. M available to Architect/Engineer to facilitate spot checks during testing.

3.4 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.5 ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.6 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide design supply, return, and exhaust air quantities.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.

G. Provide system schematic (in floor-plan or line-diagram view) with outlets and inlets numbered with the reference numbers used in the TAB Agent's tabular data, and with required and actual air quantities recorded at each outlet or inlet.
   1. Indicate locations of duct traverses.

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2. Indicate locations of duct pressure sensors, airflow monitoring stations, a which require measurements for control settings.

H. Measure static air pressure conditions on air supply units, air return units, exhau heat recovery units, including pressure drops across filters, coils, dampers, mixi heat recovery devices, and total pressure across the fan. Make allowances for 5 loading of filters, and indicate actual filter drop as well as the allowances. Provide equipment diagram indicating internal components and measurement points.

I. Provide duct traverse diagrams with measurement points indicated, with readings recorded at each point, and with calculated velocity and airflow.

J. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions. Adjust at minimum position and maximum position, and use manual dampers and actuator limit stops to minimize differences.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Where available fan capacity is less than total flow requirements of individual system parts (due to system diversity), full flow in one part may be simulated by temporary restriction of flow to other parts.

M. Coordinate with Division 23 Section “Instrumentation and Controls for Mechanical Systems” for calibration of air handling units’ airflow monitoring stations. Calibrate airflow monitoring stations to ensure that airflow readings from airflow monitoring stations correspond with actual airflows.

N. Coordinate with Division 23 Section “Instrumentation and Controls for Mechanical Systems” for calibration of air handling units’ static pressure sensors and determination of pressure setpoints.

O. Set pattern-control vanes and other devices in air inlets and outlets to provide the spread and throw patterns indicated, without objectionable noise or air motion to the occupants. Split the flow of linear slot diffusers in directions as required for good coverage. At completion, patterns shall be uniform and pleasing to the eye.

3.7 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

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E. Effect adjustment of water distribution systems by means of balancing cocks, v fittings. Do not use service or shut-off valves for balancing.

F. Where available pump capacity is less than total flow requirements of individua (due to system diversity), full flow in one part may be simulated by temporary r flow to other parts.

G. Coordinate with Division 23 Section "Instrumentation and Controls for Mechanical Systems" for calibration of pump static pressure sensors and determination of pressure setpoints.

H. When the available pump head is more than 15 percent above the required head to meet the design flow, trim the pump impeller to bring the head within 100 to 110 percent of the required head to meet the design flow. At least one balancing valve in the system, and one balancing valve per each multi-circuit sub-main branch served by a branch balancing valve, shall be fully open when balancing is complete.

3.8 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:
   1. HVAC Pumps
   2. Air Coils
   3. Terminal Heat Transfer Units
   4. Air Handling Units
   5. Makeup Air Units
   6. Fans
   7. Air Inlets and Outlets
   8. Kitchen Hood

B. Report Forms:
   1. Title Page:
      a. Name of Testing, Adjusting, and Balancing Agency
      b. Address of Testing, Adjusting, and Balancing Agency
      c. Telephone number of Testing, Adjusting, and Balancing Agency
      d. Project name
      e. Project location
      f. Project Architect
      g. Project Engineer
      h. Project Contractor
      i. Project altitude
      j. Report date
   2. Summary Comments:
      a. Design versus final performance
      b. Notable characteristics of system
      c. Description of systems operation sequence
      d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
      e. Nomenclature used throughout report
      f. Test conditions
   3. Instrument List:
      a. Instrument
      b. Manufacturer

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c. Model number
d. Serial number
e. Range
f. Calibration date

4. Electric Motors:
   a. Manufacturer
   b. Model/Frame
   c. HP/BHP
   d. Phase, voltage, amperage; nameplate, actual, no load
   e. RPM
   f. Service factor
   g. Starter size, rating, heater elements
   h. Sheave Make/Size/Bore
5. V-Belt Drive:
   a. Identification/location
   b. Required driven RPM
   c. Driven sheave, diameter and RPM
   d. Belt, size and quantity
   e. Motor sheave diameter and RPM
   f. Center to center distance, maximum, minimum, and actual
6. Variable Frequency Drive (VFD):
   a. Motor(s) served
   b. Manufacturer
   c. Model/Frame
   d. HP/BHP ratings
   e. Phase, voltage, amperage; nameplate, actual, no load
   f. Input and output frequency (Hz)
   g. Reference speed command from control system
   h. Carrier frequency setting
   i. Speeds programmed out for vibration
   j. Speed adjustment for motor balancing (if allowed)
7. Pump Data:
   a. Identification/number
   b. Manufacturer
   c. Size/model
   d. Impeller
   e. Service
   f. Design flow rate, pressure drop, BHP
   g. Actual flow rate, pressure drop, BHP
   h. Discharge pressure
   i. Suction pressure
   j. Total operating head pressure
   k. Shut off, discharge and suction pressures
   l. Shut off, total head pressure
8. Combustion Test:
   a. Boiler manufacturer
   b. Model number
   c. Serial number
   d. Fuel type
   e. Firing rate
   f. Fuel tank fill level

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g. Oil pump inlet pressure/vacuum
h. Overfire draft
i. Gas meter timing dial size
j. Gas meter time per revolution
k. Gas pressure at meter outlet
l. Gas flow rate
m. Heat input
n. Burner manifold gas pressure
o. Percent carbon monoxide (CO_2)
p. Percent carbon dioxide (CO_2)
q. Percent oxygen (O_2)
r. Percent excess air
s. Flue gas temperature at outlet
t. Ambient temperature
u. Net stack temperature
v. Percent stack loss
w. Percent combustion efficiency
x. Heat output

9. Air Cooled Condensing Unit:
   a. Identification/number
   b. Location
   c. Manufacturer and Model number
   d. Serial number
   e. Entering DB air temperature, design and actual
   f. Leaving DB air temperature, design and actual
   g. Number of compressors
   h. Refrigerant and oil types and quantities
10. Heating Coil Data:
   a. Identification/number
   b. Location
   c. Service
   d. Manufacturer
   e. Rows, and fins per inch
   f. Air flow, design and actual
   g. Water flow, design and actual
   h. Water pressure drop, design and actual
   i. Entering water temperature, design and actual
   j. Leaving water temperature, design and actual
   k. Entering air temperature, design and actual
   l. Leaving air temperature, design and actual
   m. Air pressure drop, design and actual
11. Air Moving Equipment:
   a. Location
   b. Manufacturer
   c. Model number
   d. Serial number
   e. Arrangement/Class/Discharge
   f. Air flow, specified and actual
   g. Return air flow, specified and actual
   h. Outside air flow, specified and actual
   i. Total static pressure (total external), specified and actual

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j. Inlet pressure
k. Discharge pressure
l. Component pressure drops
m. Sheave Make/Size/Bore
n. Number of Belts/Make/Size
o. Fan RPM

12. Exhaust Fan Data:
    a. Location
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Air flow, specified and actual
    f. Total static pressure (total external), specified and actual
    g. Inlet pressure
    h. Discharge pressure
    i. Sheave Make/Size/Bore
    j. Number of Belts/Make/Size
    k. Fan RPM
13. Duct Traverse:
    a. System zone/branch
    b. Duct size
    c. Area
    d. Design velocity
    e. Design air flow
    f. Test velocity
    g. Test air flow
    h. Duct static pressure
    i. Air temperature
    j. Air correction factor
14. Air Distribution Test Sheet:
    a. Air terminal number
    b. Room number/location
    c. Terminal type
    d. Terminal size
    e. Area factor
    f. Design velocity
    g. Design air flow
    h. Test (final) velocity
    i. Test (final) air flow
    j. Percent of design air flow

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SECTION 230713 – DUCT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ductwork Insulation.

B. Fire Resistive Duct Wrap for Kitchen Grease Exhaust.

1.2 RELATED SECTIONS

A. Division 09 Section "Painting": Painting insulation jackets.

B. Division 23 Section "Identification for HVAC Piping and Equipment."

C. Division 23 Section "Metal Ducts": Factory-insulated flexible ductwork.

D. Division 23 Section "Metal Ducts": Ductwork.

1.3 REFERENCES

A. Division 01 Section "References": Requirements for references and standards.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.

D. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board.

E. ASTM C356 - Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat.

F. ASTM C411 - Standard Test Method for Hot Surface Performance of High Temperature Thermal Insulation.

G. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

H. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

I. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

J. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation.

K. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).

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L. ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorpti
Mineral Fiber Insulation.

M. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Ret
Thermal Insulation.

N. ASTM C1482 - Standard Specification for Polyimide Flexible Cellular Thermal and Sound Absorbing Insulation.

O. ASTM D1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.

P. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.

Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

R. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

S. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

T. ASTM E119 (UL 263) - Standard Test Methods for Fire Tests of Building Construction and Materials.

U. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

V. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

W. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

X. ASTM E2336 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.

Y. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

Z. ISO 6944 - 1985 - Fire Resistance Tests - Ventilation Ducts.

AA. NAIMA - National Insulation Standards.

BB. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

CC. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

DD. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

EE. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

FF. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

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1.4 SUBMITTALS

A. Division 01 Section "Submittal Procedures".

B. Product Data: Provide product description, thermal characteristics, list of mate thickness for each service, and locations.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years' experience.

B. Applicator Qualifications: Company specializing in performing the work of this Section with minimum 3 years' experience.

1.6 REGULATORY REQUIREMENTS

A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723. For elastomeric foam insulation, rating shall apply for thicknesses up to 2 inches (50 mm).

B. Insulation materials shall be asbestos free. No fibers with dimensions similar to asbestos fibers shall be released from any material.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section "Product Requirements": Transport, handle, store, and protect products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section "Product Requirements": Environmental conditions affecting products on site.

B. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

C. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Glass and Mineral Fiber Products:
   1. Knauf Insulation.

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2. Certainteed Corporation.
3. Johns Manville.
4. Owens Corning.
5. No substitutions.

B. Fire-resistive Duct Blankets for Kitchen Grease Exhaust:
1. 3M Company – Fire Barrier Duct Wrap 615+.
2. Thermal Ceramics Inc. – FireMaster FastWrap XL.
3. Unifrax Corporation – FyreWrap Elite 1.5.
4. No substitutions.

C. Glass Fiber Insulation Sealing Tapes:
1. Venture Tape Corporation.
2. 3M Company.
3. Ideal Tape Co., division of American Biltrite Inc.
4. Nashua Tape Products, division of Berry Plastics Corp.
5. No substitutions.

D. Accessories:
1. Ceel-Co division of Johns Manville (product: plastic jacket systems).
2. Foster Products, division of Specialty Construction Brands, Inc., a subsidiary of H.B. Fuller (mastics, sealants, reinforcing membranes, and accessories).
3. Johns Manville (products: Super-Seal acrylic polymer coatings, Zeston plastic jacket systems).
4. Pabco/Childers Metals, division of ITW Insulation Systems (products: metal jacket systems, and accessories).
5. Vac Systems International (product: Tough Coat acrylic polymer mechanical insulation repair coating).
6. Venture Tape Corporation (product: Jacket for outdoor insulation).

2.2 GLASS FIBER, FLEXIBLE

A. Insulation: ASTM C553; flexible, noncombustible blanket.
1. 'K' ('Ksi') value: ASTM C518, 0.27 at 75 degrees F (0.039 at 24 degrees C).
2. Maximum service temperature: 250 degrees F (121 degrees C) faced and 350 degrees F (176 degrees C) unfaced.
3. Maximum moisture absorption: 0.20 percent by volume.
4. Minimum density: 1.0 lb/cu. ft. (16 kg/m^3).

B. Vapor Barrier Jacket:
1. ASTM C1136, Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier film. Facing as required for the application. Integral staple flap on one edge.
   a. Aluminum Faced: FSK (aluminum foil-scrim-kraft) construction.
   b. White Faced: PSK (polypropylene-scrim-kraft) construction.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Suitable for insulation surface temperatures up to 150 degrees F (66 degrees C).
4. Overlap longitudinal laps and butt strips.
5. Secure with outward clinch expanding staples and vapor barrier mastic and pressure sensitive tape.

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C. Vapor Barrier Tape: See article "Glass Fiber Insulation Sealing Tape" in this S

D. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compati insulation, black color.

E. Tie Wire: Annealed steel, 16 ga (1.5 mm).

2.3 GLASS FIBER, RIGID

A. Insulation: ASTM C612; rigid, noncombustible blanket. Supplied in board form.
   1. 'K' ('Ksi') value: ASTM C518, 0.24 at 75 degrees F (0.036 at 24 degrees C).
   2. Maximum service temperature: 450 degrees F (232 degrees C).
   3. Maximum moisture absorption: 1.0 percent by volume.
   4. Density: 3.0 lb/cu. ft. (48 kg/cu m).

B. Vapor Barrier Jacket:
   1. ASTM C1136, kraft paper reinforced with glass fiber yarn and bonded to aluminized film. Facing as required for the application.
      a. Aluminum Faced: FSK (foil-scrim-kraft) construction
      b. White Faced: ASJ (all-service jacket) construction.
   2. Moisture vapor transmission: ASTM E96; 0.02 perm.
   3. Suitable for insulation surface temperatures up to 150 degrees F (66 degrees C).
   4. Overlap longitudinal laps and butt strips.
   5. Secure insulation with mechanical fasteners to substrate, and seal jacket with pressure sensitive tape.

C. Vapor Barrier Tape: See article "Glass Fiber Insulation Sealing Tape" in this Section.

D. Indoor Vapor Barrier Finish:
   1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight, glass fabric.
   2. Vinyl emulsion type acrylic, compatible with insulation, [black] [white] color.

2.4 GLASS FIBER INSULATION SEALING TAPE

A. Self-adhesive tape with integral vapor barrier, pressure sensitive acrylic-based or rubber-based adhesive, and release liner strip. Width 3 inch (76 mm) nominal.

B. Manufactured by VentureTape, by the insulation manufacturer, or by one of the other tape manufacturers listed in the article "Manufacturers" in this Section.

C. Types:
   1. For rigid and semi-rigid insulations, tape shall be reinforced type. For flexible "duct wrap" insulation, tape shall be either reinforced or non-reinforced.
   2. White or aluminum outer surface to match the insulation.
   3. Reinforced: Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier layer.
      a. Aluminum Finish with FSK: VentureTape 1525CW.
      b. White Finish with ASJ: VentureTape 1540CW
      c. White Finish with PSK: VentureTape 1531CW.
   4. Non-Reinforced: Foil insulation tape. Dead-soft temper 2 mil (0.05 mm) thick

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aluminum foil, without reinforcement. Hand-tearable.
a. Venture Tape 3520CW.

5. Performance:
   a. Peel Adhesion: PSTC-101 with 20 minute dwell, 45 oz/in. (12.5 N
   b. Shear Adhesion: PSTC-107, 2.2 psi (15.2 kPa) after 24 hours.
   c. Tensile Strength: PSTC-131:
      1) Reinforced Types: 40 lb/in. (180.8 N / 25 mm).
      2) Non-reinforced Types: 21 lb/in. (94.9 N / 25 mm).
   d. Elongation: PSTC 131, 6 percent maximum.
   e. Service Temperature: -40 to 240 degrees F (-40 to 116 degrees C).
   f. UL 723 listed or classified (flame/smoke rating).

2.5 FIRE RESISTIVE DUCT WRAP

A. General:
   1. Work includes labor, material, and equipment to provide 2 hour fire resistive rated grease or air duct enclosure as a shaft alternative and a method for providing zero-inch clearances around commercial kitchen grease duct exhaust systems to combustible materials.
   2. These Specifications are based on 3M Fire Barrier Duct Wrap 615+ materials. Where installation requirements of substituted products differ from these Specifications, the more stringent requirements shall apply.

B. Listing Agency: Provide products that are listed by at least one the following:
   1. Underwriters Laboratories Inc. (UL), in "Fire Resistance Directory" category XHEZ or XHBN as appropriate.
   2. Omega Point Laboratories (OPL), in "Directory of Listed Products, Through Penetration Fire Resistance Directory."
   3. Any other qualified independent testing and inspection agency that conducts periodic follow-up inspections and is acceptable to authorities having jurisdiction.

C. Furnish products identical to those tested for classification by listing agency.

D. Mark product packing with classification marking of listing agency.

E. Duct Wrap Exposed to View: Provide products with flame spread index of less than 25 and smoke developed index of less than 450, when tested in accordance with ASTM E84.

F. Duct Wrap Exposed to View, Traffic, Moisture, or Physical Damage: Provide products that after curing do not deteriorate when exposed to those conditions during and after construction.

G. Materials: Use only products specifically listed for use in Listed systems.

H. Submittals: Submit test reports substantiating performance requirements and Code compliance along with manufacturer's installation instructions.

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I. Duct Wrap: 3M Fire Barrier Duct Wrap 615+: Lightweight, non-asbestos, hig bio-soluble, calcium-magnesium-silicate (CMS) non-woven blanket, encapsula reinforced foil, blanket thickness of 1.5 inches (38 mm) for ventilation and grea applications.
   1. Color: White blanket, aluminum foil encapsulated.
   2. Weight: 0.9 psf (4.38 kg/m2).
   3. Density: 6 pcf (96.1 kg/m3) nominal.
   4. Thermal Conductivity (k-value) at 500 degrees F (260 degrees C) (ASTM C411, ASTM C518): 0.48 Btu/(ft2 x h x F) (0.07 W/(m x K)).
   5. R-Value per ASTM C518 at ambient 77 degrees F (25 degrees C): At least 6.3 F-ft2-hr/Btu (1.1 K-m2/W)..
   6. Service range up to 2000 degrees F (1093 degrees C)
   7. Fire Resistance: For use in 1 hour and 2 hour fire resistant systems.
   8. Product complies with ASTM E2336 test standard.
   9. Product complies with ISO 6944 test standard.
   10. Through-penetration per ASTM E814 (UL 1479).
   11. Non-combustible per ASTM E136.

J. Accessory Materials:
   1. Tapes:
      a. High Performance Filament Tape: 3M tape No. 898, 1inch (25 mm) wide.
      b. FSK Facing Tape: 3M tape No. 3320, with aluminum foil, fiberglass scrim, and kraft paper backing. Nominal 3 inches (76 mm) wide or 4 inches (102 mm) wide. For sealing cut blanket edges and seams.
   2. Banding Material: Stainless or carbon steel banding, 1/2 inch (13 mm) wide x 0.015 inch (0.4 mm) thick, as stated in duct wrap Design Listing.
   3. Insulation Pins and Clips:
      a. Copper-coated steel pins, 12 gauge with a minimum length of 4 inches (102 mm), with 2.5 inch (64 mm) square galvanized steel speed clips.
      b. 12 ga insulated cup head steel pins.
   4. Through-Penetration Fire Stop Materials:
      a. Packing Material: Scrap pieces of fire resistive duct wrap, 1.5inches (13 mm) thick, or 4 pcf (56 kg/m3) mineral wool.
      b. Sealant: 3M 2000+ premium non-slump silicone sealant, or other sealant as stated in the duct wrap's Design Listing.
   5. Access Doors: 3M Fire Barrier Grease Duct Access Doors.
      a. Steel angle opening frame, with threaded holes for fasteners.
      b. Access cover, minimum 16 ga, with loop handle, labeling, and fastener holes.
      c. Thumb screws for initial fastening of access cover to frame.
      d. 3M Fire Barrier Grease Duct Access Door Hardware Extension Kit, including threaded rods, wing nuts, nuts, and washers.
      e. Outer plate, minimum 16 ga steel, field furnished.
      f. Layers of fire-resistant duct wrap, sized per manufacturer's instructions, with edges sealed with aluminum foil tape.
      g. Insulation pins and speed clips to fasten the layers of duct wrap to the inside face of outer steel plate.
      h. Label for outer plate.

K. Execution: See Part 3 of this Section.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section "Project Management and Coordination": Verification of e conditions before starting work.

B. Verify that ductwork has been tested before applying insulation materials.

C. Verify that surfaces are clean, foreign material removed, and dry.

D. Verify that insulation materials are clean and dry. Discard any materials that exhibit signs of moisture damage, contamination, mold, mildew, or other biological growth. Discard any materials used in the air handling airstream if they have been exposed to water.

3.2 INSTALLATION

A. Division 01 Section "Quality Requirements": Manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Provide insulation for surfaces of ductwork, as indicated and specified. Insulation values shall meet or exceed the requirements of ASHRAE 90.1-2010, State Energy Codes, and Table I, whichever is greater. In addition, comply with the other requirements of this Section.

D. Insulated Ductwork Conveying Air below Ambient Temperature:
   1. Provide insulation with vapor barrier jackets.
   2. Finish with tape and vapor barrier jacket.
   3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
   4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

E. Insulated Ductwork Conveying Air above Ambient Temperature:
   1. Provide with or without standard vapor barrier jacket.
   2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

F. Ductwork Exposed below 10 feet (3 meters) above finished floor in Mechanical Equipment Rooms: Provide glass fiber rigid insulation with vapor barrier jacket.

G. Do not insulate exposed heating or cooling supply ductwork in the conditioned spaces which it serves, unless otherwise specified or indicated on the Drawings.

H. Wherever exposed ductwork for air conditioned systems passes through non air conditioned spaces, insulate ductwork with glass fiber rigid insulation with vapor barrier, to prevent condensation.

I. Where rigid glass fiber insulation is scheduled, semi-rigid glass fiber insulation may be used on round and flat oval ducts and irregular shapes, and preformed pipe insulation may be used on small diameter round ducts.

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J. Ensure that surface is clean and dry prior to installation. Ensure that insulation during application. Finish with system at operating conditions.

K. Ensure that insulation is continuous through inside walls. Pack around ducts w supporting insulation material, properly sealed.

L. Finish insulation neatly at hangers, supports and other protrusions.

M. Locate insulation or cover seams in least visible locations.

N. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.

O. Standing seams, supporting angles and flanges on insulated ductwork shall be insulated with thickness equal to the duct and edges shall be finished and vapor sealed.

P. For supply or return ductwork which is required to be insulated, insulation shall be continuous and shall include the insulating of register, grille and diffuser connection plenums/boots.

Q. Mechanical fasteners shall not be riveted or screwed to the duct and shall not penetrate the metalwork.

3.3 FIRE RESISTIVE DUCT WRAP FOR KITCHEN GREASE EXHAUST

A. Install duct wrap system in accordance with manufacturer's instructions and referenced standards.

B. Install duct wrap in direct contact with the duct it encloses. Install in accordance with details of the product's Listing. Protect every portion of duct with no less than 2 layers. Overlap both perimeter and longitudinal joints minimum of 3 in. (76 mm) per layer of material. If required, tape seams using minimum 3 in. (76 mm) wide aluminum foil self-adhesive tape.

C. Air Duct Enclosure Wrap: Follow same traditional wrap method with exception of utilizing a 3 in. (76 mm) perimeter overlap in conjunction with longitudinal butt joint wrap plus duct wrap collar over exterior layer joints.

D. Filament tape may be used as a temporary securing measure on both layers until banding hardware is in place. Band exterior layer spaced no more than 10.5 in. (267 mm) on center, and within 1.5 in. (39 mm) of overlapped seams.

E. For duct widths greater than 24 inches (610 mm), weld insulation pins to bottom of horizontal and outer vertical duct runs. Space on a grid in accordance with duct wrap manufacturer's instructions. Impale duct wrap over pins and secure with galvanized steel speed clips before banding is applied.

F. Locate grease duct access doors at horizontal cleanouts as required by local Codes. Protect with 3 layers of duct wrap, each layer overlapping previous by 1inch (25 mm) on all sides and in accordance with manufacturer's instructions.

G. Install duct access doors and their insulation in accordance with manufacturer's instructions. Provide labeling in accordance with NFPA 96 and Code requirements.

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H. Where fire rated duct wrap is used as a shaft enclosure, firestop at fire separatio with the duct wrap manufacturer's recommendations.

I. Protect fire wrap from damage when installed in locations accessible to building

J. Repair Procedure:
   1. Repair damaged duct wrap in accordance with manufacturer's instructions.
   2. Remove damaged section. Apply a new section of same dimension. Place and fit ensuring same overlap that existed previously. Place banding around new duct wrap material and tension to sufficiently hold in place.
   3. If damage has penetrated to interior layer, remove affected sections and reinstall as specified in Installation.

3.4 FIELD INSPECTION

A. Visually inspect to ensure that materials used conform to Specifications. Inspect installations progressively for compliance with requirements.

TABLE I
DUCTWORK INSULATION MATERIAL AND WALL THICKNESS

DUCTWORK TYPE	INSULATION MATERIAL	VAPOR BARRIER REQUIRED	INSULATION WALL THICKNESS
Outside air intake ductwork	Glass Fiber, Rigid	Yes	2 layers of 1inch (25.4 mm) with staggered joints
Supply ductwork for heating only systems with supply air temperatures less than 100 degrees F (37.7 degrees C)	Glass Fiber, Flexible	No	1 ½ inches (38.1 mm)
	Glass Fiber, Rigid	No	1inch (25.4 mm)
Supply ductwork for heating and cooling systems with heating supply air temperatures less than 100 degrees F (37.7 degrees C)	Glass Fiber, Flexible	Yes	1 ½ inches (38.1 mm)
	Glass Fiber, Rigid	Yes	1inch (25.4 mm)
Exposed supply ductwork for cooling systems that pass through non air-conditioned spaces	Glass Fiber, Rigid	Yes	1inch (25.4 mm)
Exposed supply ductwork in mechanical or equipment rooms	Glass Fiber, Rigid	No for heating only systems, Yes for cooling systems	1inch (25.4 mm)
Kitchen Hood Grease Exhaust Ductwork	Fire Resistive Duct Wrap	---	2 layers of 1-1/2 inches (38.1 mm) with staggered joints per Manufacturer's Recommendations to achieve zero clearance to combustibles

END OF SECTION 230713

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SECTION 230719 – HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

C. Shields, Inserts, and Saddles.

1.2 RELATED SECTIONS

A. Division 23 Section "Hangers and Supports for HVAC Piping and Equipment": Placement of hangers and hanger inserts.

B. Division 23 Section "Refrigerant Piping.": Placement of inserts.

1.3 REFERENCES

A. Division 01 Section "References": Requirements for references and standards.

B. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.

D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.

E. ASTM C240 - Standard Test Methods of Testing Cellular Glass Insulation Block.

F. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

G. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

H. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

I. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

J. ASTM C547 - Standard Specification for Mineral Fiber Preformed Pipe Insulation.

K. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.

L. ASTM C578 - Standard Specification for Preformed, Cellular Polystyrene Thermal Insulation.

M. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyurethane

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Thermal Insulation.

N. ASTM C610 - Standard Specification for Expanded Perlite Block and Pipe The

O. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contac Stainless Steel.

P. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

Q. ASTM D1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.

R. ASTM D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics.

S. ASTM D1667 - Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).

T. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

U. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.

V. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

W. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

X. NAIMA National Insulation Standards.

Y. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

Z. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures”.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

B. Applicator Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723. For elastomeric foam insulation, rating shall apply for thicknesses

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up to 2 inches (50 mm).

B. Insulation materials and accessories shall be asbestos-free. No fibers with dime asbestos fibers shall be released from any material.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section "Product Requirements": Transport, handle, store, and protect products.

B. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section "Product Requirements": Environmental conditions affecting products on site.

B. Maintain ambient conditions required by manufacturers of each product.

C. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Elastomeric Foam Products:
1. Armacell LLC.
2. K-Flex USA.
3. No substitutions.

B. Accessories:
1. Ceel-Co division of Johns Manville (product: plastic jacket systems).
2. Foster Products, division of Specialty Construction Brands, Inc., a subsidiary of H.B. Fuller (mastics, sealants, reinforcing membranes, and accessories).
3. Johns Manville (products: Super-Seal acrylic polymer coatings, Zeston plastic jacket systems).
4. Proto Corporation (product: plastic jacket systems).

2.2 ELASTOMERIC FOAM

A. Products:
1. Armacell: AP Armaflex and AP Armaflex FS pipe and sheet insulation.
2. K-Flex USA: Insul-Tube and K-Flex LS pipe insulation, and Insul-Sheet S2S and K-Flex LS sheet insulation.
3. No substitutions.

B. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.
1. 'K' ('Ksi') value: ASTM C177; 0.277 Btu-in/(hr-sq.ft- degrees F) at 75 degrees F (0.04 W/m-K at 24 degrees C).
2. Minimum service temperature: -70 degrees F (-57 degrees C) (flexible to -20 degrees F (-29 degrees C)).

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3. Maximum service temperature: 220 degrees F (104 degrees C).
4. Maximum moisture absorption: ASTM C209, 0.2 percent by volume; or 5 percent by weight.
5. Moisture vapor transmission: ASTM E96; 0.08 perm-inches (0.116 ng/(s
6. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D. Insulated Hanger Inserts: At Contractor's option, Armacell Armafix IPH insulated pipe hanger inserts may be used at hanger locations.
1. Engineered from Armaflex insulation, with inserts of CFC-free PPUR/PIR polyurethane foam insulation bearing segments.
2. Outer shell of 30 mils (0.76 mm) -thick painted aluminum.
3. Self-adhesive closure strip.
4. Provide Armaflex insulation tape, wrapped around the IPH prior to placing in the hanger.

2.3 SHIELDS, INSERTS, AND SADDLES

A. Shields:
1. Carpenter and Paterson Figure 265GS, or equal.
2. Galvanized or electro-galvanized steel, minimum 12 inch length, minimum 120-degree arc, minimum 18 ga.
3. Provide contact adhesive to glue shields to the insulation.

B. Snap-On Shields:
1. Cooper B-Line "Snap-N Shield".
2. Snap-N Shield is an acceptable substitute for metal shields when installed with strut trapeze hangers on horizontal piping.
3. Paintable polypropylene plastic 12 inch long preformed shields, snap-on design for attachment to strut.
4. Gluing is not required with Snap-N Shield.
5. Provide black or white color to match the insulation in areas exposed to public view.

C. Saddles:
1. Factory fabricated of curved carbon steel plate, of same overall thickness and contour as adjoining insulation. Sides designed for welding to pipe. Center support plate for pipe sizes 12 inches (300 mm) and larger.

2.4 MANUFACTURER'S STAMP OR LABEL

A. Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to the project site for use shall have the manufacturer's stamp or label attached giving name of manufacturer, brand, and description of material. Insulation packages and containers shall be asbestos-free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

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B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Division 01 Section "Quality Requirements": Manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards where applicable.

C. Provide insulation for surfaces of new piping as indicated and specified.

D. Insulation values shall meet or exceed the requirements of ASHRAE 90.1-2010, applicable State Energy Codes, and Table I, whichever is greater. In addition, comply with the other requirements of this Section.
   1. International Energy Conservation Code (IECC): Chapter 5 of the Code allows the use of ASHRAE 90.1 insulation thicknesses instead of the Minimum Pipe Insulation table which is in Chapter 5 of the IECC. This Specification does not reference the table in IECC.

E. Piping systems requiring insulation, types of insulation required, and insulation thickness shall be as listed in Table I herein. For piping not listed in Table 1, insulate to meet Code requirements, using suitable specified materials, subject to Architect's approval. Except for flexible unicellular insulation, insulation thicknesses as specified in Table I shall be one inch (25 mm) greater for insulated piping systems located outside the building and in unconditioned spaces. Unless otherwise specified, insulate fittings, flanges, and valves, except valve stems, hand wheels, and operators. Use factory pre-molded, precut, or field-fabricated insulation of the same thickness and conductivity as used on adjacent piping. Insulation exterior shall be factory cleanable, grease resistant, non-flaking, and non-peeling.

F. Exposed Piping: Locate insulation and cover seams in least visible locations.

G. Insulated Pipes Conveying Fluids Below Ambient Temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

H. Glass Fiber Insulated Pipes Conveying Fluids below Ambient Temperature:
   1. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

I. Shields, Inserts, and Saddles:
   1. Application: Provide shields at hangers. Provide inserts for piping 2 in. (50 mm) nominal size or larger. Provide saddles for piping 6 in. (150 mm) nominal size and larger and for generator exhaust piping and muffler.
   2. Shield location: Between insulation jacket and hanger.
   3. Saddle location: Between support shield and piping.
   4. Tack-weld saddles to the pipe or muffler. Fill air spaces within the saddle with insulation material.
   5. Glue shields to outside of insulation after system is filled and run at operating temperature.
   6. Align mid-length of shields, inserts, and saddles with the hanger centerline.

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J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetra
supports, protrusions, and interruptions. At fire separations, refer to Division 0

K. Exterior Applications:
1. Cover with PVC jacket and fitting covers with seams located on bottom s
piping.

3.3 UNIFORM INSTALLATION

A. Systems shall use a single insulation type throughout the installation.

3.4 PREPARATION

A. Insulate piping after system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust, and scale and dried. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction of valve handles, safety reliefs, and other components requiring movement. Allow adequate space for pipe expansion. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Insulation shall be continuous through sleeves, wall and ceiling openings. Extend surface finishes to protect surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer's recommended coverage per gallon. Individually insulate piping. Provide a moisture and vapor seal where insulation terminates against metal hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Keep insulation dry during the application of any finish. Bevel and seal the edges of exposed insulation. Unless otherwise indicated, do not insulate the following:
1. Piping in radiation enclosures, or within cabinets of unit heaters.
2. Valve hand wheels.
3. Fire protection pipes.
4. Vibration isolating connections.
5. Adjacent insulation.
6. ASME stamps.

3.5 PIPING INSULATION

A. Elastomeric Foam Insulation: Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide mineral-fiber insulation inserts and sheetmetal sleeves. Insulate flanges, unions, valves, and fittings in accordance with manufacturer's published instructions. Apply two coats of vinyl lacquer finish to elastomeric foam insulation before applying PVC jacket in outside locations.

B. Sleeves and Wall Chases: Where penetrating interior walls, extend a metal jacket 2 inches (51 mm) out on either side of the wall and secure on each end with a band. Where penetrating floors, extend a metal jacket from a point below the back-up material to a point 10 inches (254 mm) above the floor with one band at the floor and one not more than one inch from end of metal jacket. Where penetrating exterior walls, extend the metal jackets through the sleeve to a point 2 inches (51 mm) beyond the interior surface of the wall.

3.6 FIELD INSPECTION

A. Visually inspect to ensure that materials used conform to specifications. Inspect installations

progressively for compliance with requirements.

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TABLE I
PIPING INSULATION MATERIAL AND WALL THICKNESS

SERVICE	INSULATION MATERIAL	VAPOR BARRIER REQUIRED	INSULATION WALL THICKNESS AT THE FOLLOWING PIPE DIAMETERS				
			<1 inch	1 inch to <1.5 inches	1.5 inches to <4 inches	4 inches to <8 inches	8 inches or Greater
Refrigerant Suction and Liquid Piping							
Operating Temperature							
40 degrees F and above	Elastomeric Foam	N/A	0.75 inch	1 inch	1 inch	1.5 inches	2 inches
Below 40 degrees F	Elastomeric Foam	N/A	1 inch	1 inch	1 inch	1.5 inches	2 inches

END OF SECTION 230719

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Date: 10/31/13

From: Fisher, Steve
Sent: Wednesday, November 16, 2011 4:43 PM
To: Sarno, Geoff; Donovan, Phil
Subject: RE: Insul-Tube application question

I ran some ISO Calc calculations with various temperatures and humidity levels to give the client an indication of what thickness he would need to prevent condensation. He can look at these worse case scenarios to see what thickness he should recommend for project. If further analysis is needed, please advise.

Project	**Chilled Water**
Company	**H A R R I M A N Architects + Engineers**
Comments	**11/16/2011**
Prevention of Condensation on Pipes	

Ambient Temperature	Temperature of Medium	Tube Diameter	Insulation Material	Rel. humidity (30%-95%)	Dewpoint Temperature	Minimum Thickness of Insulation
90	44	8	Insul tube	75	80.99	0.6
90	44	8	Insul tube	80	82.99	0.8
90	44	8	Insul tube	85	84.87	1.1
90	44	8	Insul tube	90	86.66	1.7
90	44	8	Insul tube	95	88.37	3.2
95	44	8	Insul tube	75	85.82	0.6
95	44	8	Insul tube	80	87.85	0.9
95	44	8	Insul tube	85	89.77	1.2
95	44	8	Insul tube	90	91.6	1.8
95	44	8	Insul tube	95	93.34	3.4

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SECTION 232300 – REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping.

B. Refrigerant.

C. Moisture and Liquid Indicators.

D. Valves.

E. Strainers.

F. Check Valves.

G. Pressure Relief Valves.

H. Filter-Driers.

I. Receivers.

J. Flexible Connections.

1.2 RELATED SECTIONS

A. Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Division 26 "Electrical."

1.3 REFERENCES

A. ARI 495 - Refrigerant Liquid Receivers.

B. ARI 710 - Liquid Line Dryers.

C. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter-Driers

D. ARI 750 - Thermostatic Refrigerant Expansion Valves.

E. ARI 760 - Solenoid Valves for Use With Volatile Refrigerants.

F. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

G. ASHRAE 34 - Number Designation of Refrigerants.

H. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

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I. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittir

J. ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes.

K. ASME B31.5 - Refrigeration Piping.

L. ASME B31.9 - Building Services Piping.

M. ASME SEC 8D - Boilers and Pressure Vessels Code, Rules for Construction of Pressure Vessels.

N. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

O. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

P. ASTM B88 - Seamless Copper Water Tube.

Q. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

R. ASTM F405 - Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings.

S. ASTM F667 - Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings.

T. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

U. AWS A5.8 - Brazing Filler Metal.

V. AWS D1.1 - Structural Welding Code, Steel.

W. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

X. MSS SP69 - Pipe Hangers and Supports - Selection and Application.

Y. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

Z. UL 429 - Electrically Operated Valves.

1.4 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.

B. Liquid Indicators:
   1. Use line size liquid indicators in main liquid line leaving condenser.
   2. If receiver is provided, install in liquid line leaving receiver.
   3. Use line size on leaving side of liquid solenoid valves.

C. Valves:

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1. Use service valves on suction and discharge of compressors.
2. Use gauge taps at compressor inlet and outlet.
3. Use gauge taps at hot gas bypass regulators and at filters and filter driers,
4. Use check valves on compressor discharge.
5. Use check valves on condenser liquid lines on multiple condenser system

D. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.

E. Strainers:
1. Use line size strainer upstream of each automatic valve.
2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
3. On steel piping systems, use strainer in suction line.
4. Use shut-off valve on each side of strainer.

F. Pressure Relief Valves: Use on ASME receivers and on compressors converted to higher pressure refrigerant. Pipe field-installed valves and valves furnished with equipment to outdoors as required by ASHRAE Standard 15 and where directed.

G. Permanent Filter-Driers:
1. Use in low temperature systems.
2. Use in systems utilizing hermetic compressors.
3. Use filter-driers for each solenoid valve.

H. Replaceable Cartridge Filter-Driers:
1. Use vertically in liquid line adjacent to receivers.
2. Use with filter elements in suction line. Provide temporary wax removal filter-drier core in low temperature systems and systems where motor failure has occurred.
3. Use filter-driers for each solenoid valve.

I. Solenoid Valves:
1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.
2. Use in liquid line of single or multiple evaporator systems.
3. Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.

J. Receivers:
1. Use on systems 5 tons (18 kW) and larger, sized to accommodate pump down charge.
2. Use on systems with long piping runs.

K. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

1.5 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.

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C. Product Data: Provide general assembly of specialties, including manufacturer' information. Provide manufacturer's catalog data including load capacity.

D. Pipe Sizing Recommendations of Equipment Manufacturers:
   1. Verify indicated pipe sizes with the manufacturers of the associated equi manufacturer's recommendations differ from the sizes indicated on the D recommendations to the Architect. The Architect will make the final determination of pipe sizes. Provide sizes per final determination at no additional cost to the Owner. In sizing piping, include modifications as required to affected items including but not limited to piping, valves, filters, other pipeline accessories, insulation, supports, sleeves, conduits, building openings, and building enclosures.
   2. Submission of manufacturer's recommendations, and equipment performance related to pipe sizing, is the Contractor's responsibility.
   3. Verify sizing prior to any preparation for piping installation.

E. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

F. Test Reports: Indicate results of leak test, acid test.

G. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

H. Submit welders' certifications of compliance with AWS D1.1., and their assigned identification letters, numbers or symbols.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section "Closeout Procedures."

B. Record exact locations of equipment and refrigeration accessories on record drawings.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section "Operation and Maintenance Data."

B. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.8 QUALIFICATIONS

A. Installer: Company specializing in performing the work of this Section with minimum 3 years' experience.

B. Design piping system under direct supervision of a Professional Engineer experienced in design of this work and licensed at the place where the Project is located.

1.9 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor

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regulations.

C. Welders Certification: In accordance with AWS D1.1. and state and local requi

D. Products Requiring Electrical Connection: Listed and classified by UL, as suita purpose indicated.

E. Refrigerant Safety: Conform with ASHRAE 15, state and local codes and manufacturer's requirements for safe handling to avoid exposure to workers or to occupants.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01 Section "Product Requirements."

B. Deliver and store piping and specialties in shipping containers with labeling in place.

C. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

D. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 - PRODUCTS

2.1 PIPING

A. Copper Tubing: ASTM B280, Type ACR hard drawn, degreased, nitrogen charged and sealed. Annealed (soft) tubing may be used only for underfloor or below grade runs or for short (6 feet (1.8 m) or less) above-grade connections to valves and equipment.
   1. Fittings: ASME B16.22 wrought copper.
      a. Fittings shall be packaged and labeled for ACR use.
      b. Elbows: Use long-radius elbows wherever possible. Do not use 45-degree elbows, because they are more likely to break at their inner surface in refrigeration service.
   2. Joints:
      a. Braze, 15 percent silver for copper, brass, and bronze.
      b. Braze, 35 percent silver, for brazing to ferrous metals (steel).
      c. Solder (for use only at equipment and valve connections where required by the equipment manufacturer).
      d. Other: If a valve or equipment manufacturer recommends a joint material other than those specified, submit it for approval.
      e. Flux: Use as recommended by alloy manufacturer. Should not be needed for copper-to-copper brazed joints.

B. Copper Tubing to 7/8 inch (22 mm) OD: ASTM B88, Type K, annealed.
   1. Fittings: ASME B16.26 cast copper.
   2. Joints: Flared.

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2.2 BRAZING MATERIALS - 15% Silver

A. Manufacturers:
1. Harris (Product: Stay-Silv 15).
2. Lucas-Milhaupt (Product: Sil-Fos 15).
3. Wolverine (Product: Silvaloy 15).
4. No substitutions.

B. Nominal Composition: 5.0 percent phosphorus, 15.0 percent silver, 0.15 percent other elements (total), remainder copper. Cadmium-free.

C. Physical Properties:

1.	Color:	Yellow/Gray
2.	Solidus:	1190 degrees F (643 degrees C)
3.	Liquidus:	1480 degrees F (802 degrees C)
4.	Brazing Range:	1300–1500 degrees F (704-816 degrees C)
5.	Electrical Conductivity:	9.9 percent IACS
6.	Electrical Resistivity:	17.40 microhm-cm

D. Specification Compliance:
1. ANSI/AWS A5.8, class BCuP-5
2. ASME SFA5.8, class BCuP-5
3. Optional:
   a. QQB 650C, class BCuP-5
   b. QQB 654A, class BCuP-5
   c. QQB 654, class BCuP-5

E. Flux:
1. Harris (Stay-Silv For copper-to-brass joints. No flux required for copper-to-copper joints).

2.3 BRAZING MATERIALS – 35 percent Silver

A. Manufacturers:
1. Harris (Product: Safety-Silv 35).
2. Lucas-Milhaupt (Product: Braze 351).
3. Wolverine (Product: Silvaloy A-35).
4. No substitutions.

B. Nominal Composition: 35.0 percent silver, 33 percent Zinc, 0.15 percent other elements (total), remainder copper. Cadmium-free.

C. Physical Properties:

1.	Color:	Yellow/Gray
2.	Solidus:	1250 degrees F (677 degrees C)
3.	Liquidus:	1410 degrees F (732 degrees C)
4.	Electrical Conductivity:	19.8 percent IACS
5.	Electrical Resistivity:	8.2 microhm-cm

D. Specification Compliance:
1. ANSI/AWS A5.8, class BAg-5

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2. ASME SFA5.8, class BCuP-5

E. Flux:
1. Harris (Stay-Silv white flux, or where heating cycles are extended, Stay-

2.4 REFRIGERANTS AND LUBRICANTS

A. Refrigerant: ASHRAE 34;
1. R-410a: Blend of R-32/125. Suitable for new equipment.

B. Oils and Other Lubricants: Provide as required by the refrigerant manufacturer and the equipment manufacturer(s).

2.5 MOISTURE AND LIQUID INDICATORS

A. Manufacturers:
1. Sporlan Valve Co, Model "See-All".
2. Emerson Climate Technologies.
3. Henry Technologies.
4. Mueller.

B. Indicators: Double port type, UL listed, with steel body, flared or copper plated solder ends, leak proof fused sight glass, replaceable color coded paper moisture indicator and plastic cap; for maximum working pressure of 500 psig (3450 kPa) for connection sizes 1-1/8 inch (29 mm) O.D. and smaller, 430 psig (2960 kPa) for sizes 1-3/8 inch (35 mm) O.D. and larger, and maximum temperature of 200 degrees F (93 degrees C). Synthetic gaskets are not allowed.

2.6 VALVES

A. Diaphragm Packless Valves:
1. Manufacturers:
   a. Henry Technologies.
   b. Mueller.
   c. Superior.
2. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psig (3450 kPa) and maximum temperature of 275 degrees F (135 degrees C).

B. Packed Angle Valves:
1. Manufacturers:
   a. Henry Technologies.
   b. Mueller.
   c. Superior.
2. Forged brass (or brass and copper), forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psig (3450 kPa) and maximum temperature of 275 degrees F (135 degrees C).

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C. Ball Valves:
   1. Manufacturers:
      a. Henry Technologies.
      b. Mueller.
      c. Superior.
   2. Two piece forged brass body with teflon ball seals and copper tube exten bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psig (3450 kPa) and maximum temperature of 325 degrees F (163 degrees C).

D. Service Valves:
   1. Manufacturers:
      a. Henry Technologies.
      b. Mueller.
      c. Superior.
   2. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psig (3450 kPa).

2.7 CHECK VALVES

A. Globe Type:
   1. Manufacturers:
      a. Henry Technologies.
      b. Mueller.
      c. Superior.
   2. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum working pressure of 500 psig (3450 kPa) and maximum temperature of 300 degrees F (149 degrees C).

B. Straight Through Type:
   1. Manufacturers:
      a. Henry Technologies.
      b. Mueller.
      c. Superior.

C. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psig (3450 kPa) and maximum temperature of 250 degrees F (121 degrees C).

2.8 PRESSURE REGULATORS

A. Manufacturers:
   1. Sporlan.
   2. Parker Hannifin.

B. Brass body, stainless steel diaphragm, pilot operated with internal pressure pilot, adjustable over 0 to 100 psig (0 to 690 kPa) range, for maximum working pressure of 450 psig (3100 kPa).

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2.9 PRESSURE RELIEF VALVES

A. Manufacturers:
1. Henry Technologies.
2. Mueller.
3. Superior.

B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; for standard setting; selected to ASHRAE 15.

2.10 SOLENOID VALVES

A. Manufacturers:
1. Sporlan.
2. Henry Technologies.
3. Parker Hannifin.

B. Valve: ARI 760, pilot operated, brass or steel body and internal parts, teflon seat, stainless steel stem and plunger assembly, with flared, solder, or threaded ends; for maximum working pressure of 500 psig (3450 kPa). Stem shall have a knife-edge joint to the body and shall permit manual operation in case of coil failure.

C. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

D. Electrical Characteristics: 10 to 15 watts, voltage compatible with control system, single phase, 60 Hz.

2.11 FILTER-DRIERS

A. Replaceable Cartridge Angle Type:
1. Manufacturers:
   a. Sporlan, Model CW Catch-All.
   b. Emerson Climate Technologies.
2. Shell: ARI 710, UL listed, steel with epoxy paint finish, copper sweat fittings, removable cap with zinc-plated fasteners, for maximum working pressure of 500 psig (3450 kPa), size as recommended by manufacturer.
3. Suction Filter Cartridge: Pleated media with integral end rings, stainless steel support, ARI 730 rating for capacity of the equipment served.
4. Filter/Dryer Cartridge: Pleated media with solid core molecular sieve with activated alumina, ARI 730 rating for capacity of the equipment served.
5. Wax Removal Cartridge: Molded bonded core of activated charcoal with integral gaskets, with filter surface area, desiccant volume and ARI 710 moisture rating as recommended by the manufacturer based on line size and refrigeration system horsepower (kW).

B. Permanent Straight Through Type:
1. Manufacturers:
   a. Sporlan, Model CW Catch-All.
   b. Emerson Climate Technologies.

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2. ARI 710, UL listed, steel shell with copper plated steel sweat or flare fitt molecular sieve/activated alumina desiccant filter core, for maximum wo of 500 psig (3450 kPa).
3. Rating: ARI 730 flow capacity of the equipment served.

2.12 STRAINERS

A. Straight Line or Angle Line Type:
1. Manufacturers:
a. Henry Technologies.
b. Sporlan.
c. Superior.
2. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psig (2960 kPa).

B. Straight Line, Non-Cleanable Type:
1. Manufacturers:
a. Henry Technologies.
b. Mueller.
2. Steel shell, copper plated fittings, stainless steel wire screen, for maximum working pressure of 430 psig (2960 kPa).

C. Screens: 80 mesh (0.007 in. (0.18 mm) square openings) in most uses, 60 mesh (0.010 in. (0.25 mm) square openings) in line sizes above 1-1/8 inch (29 mm), and 40 mesh (0.015 in. (0.38 mm) square openings) for use in suction lines.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

B. Comply with Federal, State, and local Codes and regulations regarding the handling and disposal of refrigerants and oil. Provide documentation of quantities installed in the system. Document handling and disposal; see “Project Closeout” in this Section.

C. Install refrigeration specialties in accordance with manufacturer's instructions.

D. Flood piping system with nitrogen when brazing.

E. Route piping in orderly manner, parallel or perpendicular to building structure, and maintain

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gradient.

F. Install annealed piping free of kinks, and with bends only as necessary.

G. Install piping to conserve building space and not interfere with use of space.

H. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

J. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required.

K. Provide liquid line replaceable cartridge (unless sealed type is indicated) filter-driers, with isolation valves and valved bypass. On low temperature systems, or after a hermetic motor burnout, provide wax removal cores. Provide upstream and downstream pressure-testing access valves.

L. Provide suction line replaceable cartridge filters, with isolation valves and valved bypass. Provide upstream and downstream pressure testing access valves. On low temperature systems, or after a hermetic motor burnout, provide temporary wax removal cores. After cleanup of the system, replace cores with filter elements for lower pressure drop.

M. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

N. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

O. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

P. Pipe Sleeves and Escutcheons:
   1. Provide sleeves, sized to fit outside the pipe insulation with at least 1/4 inch (6 mm) clearance, at penetrations of building assemblies. Interrupt insulation where required by fire ratings.
   2. Extend floor sleeves to 2 inches (50 mm) above finished floor and seal watertight.
   3. For below-grade penetrations and where indicated, provide watertight link-type pipe seals.
   4. Secure sleeves in place, and caulk, grout or firestop into the building assembly.
   5. Provide split chrome or painted escutcheons where exposed to occupancy.

Q. Provide clearance for installation of insulation and access to valves and fittings.

R. Provide access to concealed valves and fittings. Coordinate size and location of access doors with Division 08 Section “Access Doors and Frames.”

S. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

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T. Insulate piping and equipment; refer to Division 23 Sections "HVAC Piping Ins
"HVAC Equipment Insulation"

U. Fully charge completed system with refrigerant after testing.

V. Provide electrical connection to solenoid valves. Refer to Division 26 - Electric

3.3 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Division 01 Section "Quality Requirements."

B. Test refrigeration system in accordance with ASME B31.5.

C. Pressure test system with dry nitrogen to 200 psig (1470 kPa). Perform final tests at 27 inches of mercury (92 kPa) vacuum and 200 psig (1470 kPa) pressure using electronic leak detector. Test to no leakage.

D. Evacuate the system as required by Codes and by equipment manufacturer, including a vacuum test at 0.02 inches of mercury (500 microns). The system shall be valved off and tested for 2 hours with a pressure rise of no more than 0.002 inches of mercury (50 microns).

3.4 SYSTEM STARTUP

A. Lubricate motors and other moving parts as necessary before operating them.

B. Charge the system with liquid refrigerant into the low pressure side of the system, where the liquid will evaporate. Expel air from the system. Operate the compressor, condenser, water cooling pumps and evaporator fans during charging. Monitor compressor discharge pressure. Monitor oil levels for a period of 24 hours.

C. Coordinate control setpoints and wiring prior to startup.

D. Change suction filter elements if the pressure drop exceeds 1 Psi (6.9 kPa) after the initial 24 hours of operation. Change suction wax removal cores to filter elements after system cleanup.

E. Adjust expansion valve superheat using a thermistor or thermocouple temperature sensor at the bulb location and a pressure gauge at the external equalizer line (or the compressor). Adjust under full system load, and again when the system stabilizes.

F. Check the system again after seven full days of operation.

G. Periodically clean strainers until no more accumulation occurs.

3.5 PROJECT CLOSEOUT

A. Indicate exact locations of buried piping conduits on As-Built Drawings.

B. Submit records of handling and disposal of refrigerant and oil to verify compliance with Federal, State, and local Codes and regulations.

C. Submit records of installed quantities of refrigerants and oils in each system. S
manufacturer's product sheets, MSDS, and instructions in the Operation and M
Manuals.

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SECTION 233113 – METAL DUCTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal Ductwork.

B. Kitchen Hood Ductwork.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Division 23 Section "Air Duct Accessories": Kitchen hoods.

B. Division 26 – Electrical: Smoke detectors.

1.3 RELATED SECTIONS

A. Division 23 Section "Testing, Adjusting and Balancing for HVAC."

B. Division 23 Section "Hangers and Supports for HVAC Piping and Equipment": Sleeves.

C. Division 23 Section "Duct Insulation": External insulation and duct liner.]

D. Division 23 Section "Air Duct Accessories"

E. Division 23 Section "Air Outlets and Inlets."

1.4 REFERENCES

A. ASTM A 36 - Structural Steel.

B. ASTM A 90 - Standard Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

C. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

D. ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

E. ASTM A 568 - Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.

F. ASTM A 653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

G. ASTM A 1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

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H. ASTM A 1011 - Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-S
Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High S

I. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.

J. ASTM C 14 - Concrete Sewer, Storm Drain, and Culvert Pipe.

K. ASTM C 443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

L. AWS D9.1 - Welding of Sheet Metal.

M. NBS PS 15 - Voluntary Product Standard for Custom Contact-Molded Reinforced-Polyester Chemical Resistant Process Equipment.

N. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

O. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

P. NFPA 91 - Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying.

Q. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.

R. SMACNA - HVAC Air Duct Leakage Test Manual.

S. SMACNA - HVAC Duct Construction Standards - Metal and Flexible (SMACNA HVACDCS).

T. SMACNA - Fibrous Glass Duct Construction Standards.

U. UL 181 - Factory-Made Air Ducts and Connectors.

V. UL 1978 - Grease Ducts.

W. UL 2221 - Tests of Fire Resistive Grease Duct Enclosure Assemblies.

1.5 PERFORMANCE REQUIREMENTS

A. No variation of duct configuration or sizes is permitted except by written permission from the Architect. Size proposed substitutions of round ducts in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.6 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures”.

B. Shop Drawings: Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration. Submit prior to start of work.

C. Product Data: Provide data for duct materials, duct liner and duct connectors.

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D. Test Reports: Submit testing apparatus, procedures, and preliminary forms pric tests. On final reports, indicate pressure tests performed. Include date, section pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section "Closeout Procedures."

B. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Indicate additional fittings used.

1.8 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA HVACDCS.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years' experience.

B. Installer: Company specializing in performing the work of this Section with minimum 3 years' experience.

1.10 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A, NFPA 90B and NFPA 96 standards.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealants.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Flexible Ducts:
1. Flexible Technologies Group - Thermaflex product line.
2. Buckley Associates - Flexmaster Triple-Lock Buck Duct product line.
3. No substitutions.

B. Plastic Drawbands:
1. Panduit.
2. Thomas and Betts.
3. Tyton.

C. Tape for Flexible Ducts:
1. Ideal Tape Co., division of American Biltrite Inc.

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2. 3M Company.
3. Nashua Tape Products, division of Berry Plastics Corp.
4. Venture Tape Corporation.
5. No substitutions.

D. Manufactured Ductwork - Round and Flat Oval:
1. McGill AirFlow LLC, a subsidiary of United McGill Corporation.
2. Aero Heating & Ventilating, Inc.; Portland, ME.
3. Air Purchases, Inc.; Manchester, NH – spiral duct lengths.
4. Atlantic Air Products LLC; Bow, NH.
5. Central City Sheet Metal; Brewer, Caribou, and Gorham, ME.
6. Hahnel Brothers; Bangor and Lewiston, ME.
7. Hranec Corporation; Uniontown, PA.
8. Lindab, Inc. – duct fittings only.
9. Macy Industries, Inc.; Hookset, NH.
10. Monroe Metal Mfg. Inc.; Monroe, NC.
11. Northeastern Sheet Metal Inc.; Goffstown, NH.
12. Semco Inc., division of the Flakt Woods Group.
13. S.G. Torrice Co.; Wilmington, MA – spiral duct lengths.
14. Sheet Metal Connectors Inc.; Minneapolis, MN.
15. Spiral Manufacturing Co. Inc.; Minneapolis, MN.
16. Total Air Supply; Nashua, NH – spiral duct lengths.
17. No substitutions.

E. Manufactured Ductwork - Transverse Duct Connection System:
1. Ductmate.
2. HFC Enterprises; Baldwin Park, CA – Dura Flange product line, for round and flat oval ducts only.

F. Sealants:
1. Hardcast, a division of Carlisle Corporation.
2. 3M Company.
3. Ductmate.
4. Foster.
5. McGill AirSeal LLC, a subsidiary of United McGill Corporation.
6. Mon-Eco Industries, Inc - Eco product line.
7. Polymer Adhesive Sealant Systems.

2.2 MATERIALS

A. Galvanized Steel Ducts:
1. Steel sheet metal components of galvanized ductwork in this Specification Section shall be galvanized steel sheet, lock-forming quality, having G60 or heavier zinc coating (G90 minimum for outdoor or moist applications) conforming to ASTM A653 rating system and tested in accordance with ASTM A90.
2. Provide paint-grip exterior surfaces for exposed ducts, where available.
3. Sheet metal gauge shall be not less than 26 gauge (0.56 mm).

B. Carbon Steel Ducts: ASTM A1008, A1011. Also known as black iron.

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2.3 ACCESSORIES

A. Drawbands for Flexible Ducts:
   1. Stainless Steel: ½ inch (13 mm) wide with screw-driven worm gear.
   2. Plastic: Panduit PLT5H or PLT8H; Thomas and Betts Dukt-Rap, VAL-2 VAL-275X-25; or Tyton T150L or LX. Install with manufacturer's level tightening tool.

B. Tape for Flexible Ducts: Ideal-Seal 587A/B, UL 181B-FX listed, aluminum foil with pressure-sensitive acrylic adhesive, -20 to 250 degrees F (-28 to 121 degrees C) temperature range, 25.0 lb/in. width (109.4 N/25.4 mm width) tensile strength.

C. Coating for Buried Ducts: Asphalt base.

D. Concrete Ducts: ASTM C14; hub and spigot concrete sewer pipe with ASTM C443 joints, rubber gaskets.

E. Fasteners: Rivets, bolts, or sheet metal screws.

F. Sealants: See Duct Sealant portion of this Specification.

G. Hanger Rod: ASTM A36; galvanized steel; threaded both ends, threaded one end, or continuously threaded.

2.4 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVACDCS, as specified or as indicated on the drawings. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

B. SMACNA Duct Construction Manuals:
   1. The SMACNA recommendations shall be considered as mandatory requirements.
   2. Substitute the word "shall" for the word "should" in these manuals.
   3. Where the Contract Specifications differ from SMACNA recommendations, the more stringent requirements (as determined by the Architect) shall take precedence.
   4. Details on the Contract Drawings take precedence over SMACNA standards.

C. Sheet metal shall be galvanized steel as specified in Part 2 paragraph "Materials" in this Section, unless otherwise indicated or specified.

D. Construct Tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline.
   1. Where space is too restricted for full-radius elbows, provide mitered (square-throat) elbows with single wall turning vanes. Do not use air foil turning vanes.
   2. Mitered elbows in round or flat-oval ductwork shall be factory-manufactured.
   3. Radiused elbows with throat radius 1/2 times width of duct (centerline radius 1 width of duct) may be used instead of mitered elbows, but only where space is too restricted for full radius.
   4. Fittings not conforming to these requirements will be ordered removed and replaced with proper fittings.

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E. Increase duct sizes gradually, not exceeding 15 degrees divergence or converge wherever possible; maximum 30 degrees divergence (per side) upstream of equ 45 degrees convergence (per side) downstream.

F. Fabricate continuously welded round and oval duct fittings two gauges heavier indicated in SMACNA Standard. Joints shall be minimum 4 inch (100 mm) ce joint, brazed or electric welded. Prime coat welded joints.

G. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

H. Longitudinal locks or seams known as "button-punch-snap-lock" and other "snap-lock" types will not be permitted in rectangular duct. Snap-lock longitudinal seams may be used on round ducts up to 8 inches diameter, with screws provided to secure the seams at 24 inches (609 mm) on center maximum spacing.

I. Exposed Ducts: Select and handle materials with care for a neat appearance. Joint connections on round and flat oval ducts shall be sleeve or flanged type; drawbands are not acceptable.

2.5 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufactured ductwork and fittings listed below are acceptable alternatives to standard ductwork systems. For exposed round and flat oval ductwork, factory-manufactured ductwork and fittings are required.

B. Manufacture in accordance with SMACNA HVACDCS, and as specified or as indicated on the drawings. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

C. Exposed Round and Flat Oval Ductwork: Shall be manufactured ductwork by one of the listed manufacturers.
   1. Spiral Ductwork Acceptable Products:
      a. McGill Airflow: Standard Uni-Seal product line (smooth surface between spiral lockseams) or Uni-Rib product line (one standing seam reinforcement between each pair of spiral lockseams).
      b. Monroe Metal Inc.: Standard spiral product line (smooth surface between spiral lockseams). V-Rib product line is not allowed.
      c. Other Manufacturers: Standard spiral product line (smooth surface between spiral lockseams).
      d. Ductwork and fittings shall be products of a single manufacturer.

D. Exposed Ducts:
   1. Select and handle materials with care for a neat appearance.
   2. Joint connections on round and flat oval ducts shall be sleeve or flanged type; drawbands are not acceptable. Joint connections on flat oval ducts 42 inches (1.07 m) and wider shall be flanged type to ensure tight fit and good appearance.
   3. Provide exterior reinforcing only where required, with prior approval from the Architect.
   4. External reinforcement of flat-oval ducts shall be full-perimeter angle rings. Straight angles along flat sides only are not allowed.

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E. Galvanized and stainless steel sheet metal used in fabrication shall be not less th (0.551 mm) thickness. Aluminum shall be not less than 0.025 in. (0.635 mm) n thickness. This requirement supersedes SMACNA requirements.

F. Round and Flat Oval Duct and Fittings:
   1. Shall be suitable for at least 4 in. WG (996 Pa) positive pressure and 2 in negative pressure in accordance with SMACNA HVACDCS standards. This is a minimum; provide higher ratings where required.
   2. Fittings shall be fabricated of sheet metal at least one gauge heavier than straight duct of the same size.
   3. Fittings shall be factory-sealed so that no field sealing of joints between gores or segments is required. Acceptable methods of construction are fully welded, spot-welded with inner sealant, or standing-seam crimped joints.

G. Radiused Elbows in Round and Flat Oval:
   1. In exposed ductwork shall be non-adjustable type, factory-sealed.
   2. In concealed ductwork may be adjustable type, with full long radius as detailed on the Drawings. Short-radius elbows are not allowed.
   3. Shall be constructed of the following minimum number of segments or gores: 90-degree: 4 gores; 60-degree: 3 gores; 45-degree: 3 gores; 30-degree: 2 gores; 22-1/2-degree: 2 gores.
   4. 1-piece stamped elbows are acceptable up to 12 inches (305 mm) diameter. Pleated elbows are acceptable up to 10 inches (254 mm) diameter.

H. Mitered Elbows in Round and Flat Oval:
   1. Available in both 90-degree and 45-degree elbows.
   2. Shall have minimum number of welded single-wall vanes as follows (size is duct width in plane of bend):
      a. 3 to 9 inch (76 to 229 mm): 2.
      b. 10 to 14 inch (254 to 356 mm): 3.
      c. 15 to 19 inch (381 to 483 mm): 4.
      d. 20 to 60 inch (508 to 1524 mm): 5.
      e. Larger Sizes: 12-inch (305 mm) maximum spacing.

I. Inner tie-rod reinforcement is not allowed. Increase duct sheet metal gauge or external reinforcement as required.

J. Flat Oval Ducts: Machine made from round spiral lockseam duct.

K. Transverse Duct Connection System: SMACNA "F" rated or SMACNA "J" rated rigidity class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips. Product shall be Ductmate factory-manufactured connectors, or field-formed flanges using a specialized machine.

2.6 CASINGS

A. Fabricate casings in accordance with SMACNA HVACDCS and construct for operating pressures indicated.

B. Mount floor mounted casings on 4 inch (100 mm) high concrete curbs. At floor, rivet panels on

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8 inch (200 mm) centers to angles. Where floors are acoustically insulated, pro
18 gauge (1.20 mm) galvanized expanded metal mesh supported at 12 inch (30(
turned up 12 inches (300 mm) at sides with sheet metal shields.

C. Reinforce door frames with steel angles tied to horizontal and vertical plenum s
angles. Install hinged access doors where indicated or required for access to equ
cleaning and inspection.

D. Fabricate acoustic casings with reinforcing turned inward. Provide 16 gauge (1.50 mm) back facing and 22 gauge (0.80 mm) perforated front facing with 3/32 inch (2.4 mm) diameter holes on 5/32 inch (4 mm) centers. Construct panels 3 inches (75 mm) thick packed with 4.5 lb/cu ft (72 kg/cu m) minimum glass fiber media, on inverted channels of 16 gauge (1.50 mm).

2.7 KITCHEN GREASE HOOD EXHAUST DUCTWORK

A. Fabricate in accordance with SMACNA HVACDCS and NFPA 96.

B. Construct of 16 gauge (1.50 mm) carbon steel or 18 gauge (1.21 mm) type 304 or 316 stainless steel, using continuous external welded joints. Ductwork exposed to view or exposed to weather shall be stainless steel unless otherwise indicated.

C. Gaskets and sealants shall be rated for 1500 degrees F (815.6 degrees C) continuous operation.

D. Connection to Fan: Provide transition plate to fan base, of same material as duct. Outer perimeter shall be full size of fan base or curb. Inner opening shall be same size as duct and similar to fan inlet size. Inner opening shall be centered in plate to align with fan inlet and to maintain clearances. Duct shall be welded smoothly and continuously to the transition plate, preferably butt-welded to the underside of the plate or with plate corners turned down into duct, rather than duct turned out onto plate. Provide a smooth flat surface for installation of high-temperature gasket between transition plate and fan base. Fasten transition plate to the roof curb (or non-combustible wall opening).

E. Elbows:
1. Mitered: Internal turning vanes are not allowed. Mitered elbows should be avoided in grease ducts except where indicated.
2. Radiused: Provide full radius (centerline radius 1-1/2 times the duct width), continuously curved for rectangular duct, gored for round duct. In manufactured round duct, elbows may be manufacturer's standard, with throat radius as little as 6 inches (75 mm).

2.8 PRESSURE CLASSIFICATION

A. Ratings as indicated on the Drawings or as specified. See Ductwork Pressure Class Schedule in Part 3 of this Section.

B. If no ratings are indicated, ductwork shall be rated for the external static pressure of the system plus 25 percent.
1. If 4 dampers (of any type) or fewer can isolate a duct system, that portion of the system shall be rated for the shut-off pressure of the system fans.

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2.9 DUCT SEALING

A. Seal ductwork as outlined in the SMACNA HVACDCS. Seal ductwork to a mi
A (transverse joints, longitudinal seams, and duct wall penetrations), regardless
class.

B. Seal ductwork systems as required to ensure that maximum duct leakage does not exceed that allowed by the latest edition of the SMACNA HVAC Air Duct Leakage Test Manual. Allow sealant to dry in accordance with manufacturer's requirements of time and environmental conditions before ductwork systems are pressurized.

C. Duct sealing materials used shall be non-flammable and non-combustible in both liquid and solid states.

D. Seal Pittsburgh hammered lockseams by flooding the joint with sealant prior to assembly.

E. Seal exposed ducts by applying mastic-type or gasket-type sealer just before the joint or seam is made; remove excess sealant for a neat appearance.

F. Fill (with matching duct material such as sheet metal) any gaps in duct which exceed the recommendations of the sealant manufacturer, and in no case shall liquid or mastic sealant be used to fill gaps or openings which exceed 1/8 inch (3.2 mm) in any direction. Verify that system air pressure acting on a wide gap will not exert enough force to damage or loosen the sealant.

G. Materials for Sealing:
   1. Hardcast: Flex-Grip 550 or Iron-Grip 601 mastic.
   2. Hardcast: gypsum-based tape and mastic, waterproof type when used on moist-air exhaust or in humid or outdoor locations.
   3. Ductmate: Flanged lateral joints with gaskets.
   4. Ductmate: PROseal.
   5. Foster: Duct-Fas or Safetee mastic sealant. Duct-Fas is UV resistant and recommended for applications exposed to sunlight.
   6. Mon-Eco: Eco-Duct Seal 4450 (red color) or 4452 (grey color). Use grey color where ducts will be unpainted and exposed to public view.
   7. Polymer Adhesives Sealant Systems: Airseal No. 11 premium sealant.
   8. [PVC tape for PVC-coated metal ducts.]
   9. [Joints for FRP ducts]
   10. [Joints for Concrete ducts.].

2.10 UNIFORMITY OF MATERIALS

A. Ductwork accessories, including but not limited to volume dampers, smoke dampers, fire dampers, combination fire/smoke dampers, backdraft dampers and motorized dampers, shall be fabricated of materials that are similar to the ductwork in which they are installed.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components furnished under other Section and Divisions of the Specifications. Such items may include but are not limited to: Sensors and airflow measuring stations furnished under Division 23 Section "Instrumentation and Control for Mechanical Systems"; gauges and meters; and smoke detectors furnished under Division 26 – Electrical.

C. Install ducts in accordance with SMACNA HVACDCS.

D. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

E. "Fishmouth" duct connections are not allowed.

F. Inner tie-rod reinforcement is not allowed. Increase duct sheet metal gauge or external reinforcement as required.

G. Exposed Ducts:
   1. Handle with care for a neat appearance. Repair or replace dented or damaged ductwork as required by the Architect. Select hangers for appearance, and to prevent sagging or distortion of duct.
   2. Remove labels attached to ducts before receiving paint.

H. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

J. Use crimp joints with or without bead for joining round duct sizes 8 inch (200 mm) and smaller with crimp in direction of air flow.

K. Use double nuts and lock washers on threaded rod supports. Strap hangers shall be minimum 16 gauge (1.50 mm) x 1 inch (25 mm) galvanized straps. Hanger and support components including but not limited to "unistrut" shall be galvanized steel except that where other duct materials are used, the hanger materials shall be compatible and non-corrosive to the duct. Wire hangers are not acceptable.

L. Flexible Ducts:
   1. Connect diffusers or light troffer boots to low pressure supply ducts directly or with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.
   2. Minimum bend radius shall be one and one half times the duct diameter. Support the bend to maintain this radius.
   3. Bends shall not exceed 45 degrees.
   4. Connect flexible ducts to metal ducts with 2 turns of duct tape and metal draw bands. Plastic drawbands may be used if they are installed using the band manufacturer's lever-

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action tightening tool. On insulated flexible ducts, provide an additional drawband on the insulation's vapor barrier.

M. Set plenum doors 6 to 12 inches (150 to 300 mm) above floor. Arrange door sv static pressure holds door in closed position.

N. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Do not start ducted air moving equipment until construction is completed to a stage where airborne construction dust is no longer present. At the time of substantial completion, the entire air distribution system shall be turned over to the Owner clear of construction dust and debris. If the interior surfaces of any ducted air moving equipment or the interior surfaces of any portion of the ductwork distribution system are found, as determined by the Architect, to contain significant construction dust and debris, the entire air distribution system shall be cleaned in accordance with Division 23. If proper precautions are taken to prevent construction dust and debris from entering the ductwork during construction and if the Architect finds all ductwork to be free from such dust and debris, air duct cleaning shall not be required.

O. For fresh air intake and exhaust plenums connected to louvers or brick or block vents, pitch bottom of plenums down to bottom of louver at minimum 1/4 inch per foot (2 percent). Seal connections and joints on bottom of plenums watertight with mastic. Connect bottom of plenum to top-inside edge of bottom louver blade or waterstop as detailed on the Drawings, to ensure positive drainage

P. Provide floor drains in fresh air and exhaust plenums. Pitch bottom of plenums to floor drains and provide deep seal traps. Pipe traps to nearest floor drains.

Q. Install duct-mounted components furnished under other Sections of this Specification, such as smoke dampers, control dampers, control sensors, and smoke detectors. Install with straight lengths of duct as required for proper operation. Provide access at such components as required. Install in accessible locations for maintenance; notify the Architect if a location indicated or selected requires addition of access by other trades.

R. Kitchen Grease Hood Exhaust Ductwork:
1. Seams, joints, and penetrations shall have a liquidtight continuous external weld.
2. Connect to hood as required by the Mechanical Code, NFPA 96, and manufacturer's instructions. If a factory raised angle collar is provided with the hood, provide a compatible angle on the duct end, and weld continuously or provide a bolted and gasketed connection to allow disassembly. If no factory collar is provided, insert the duct 1 inch into the hood and weld continuously. Do not field-modify or cut the hood with written permission from the Architect.
3. At fan, provide a fan adapter of same construction as duct, with flat plate the full size of fan base or curb. Weld duct continuously to the plate, centered to maintain clearances to curb and straight inlet to fan. Provide a smooth flat surface for installation of fan gasket.
4. Ducts shall not pass through fire walls or fire partitions.
5. Clearances: Maintain minimum 18 inches (460 mm) from ductwork to combustible materials and minimum 3 inches (77 mm) from ductwork to limited combustible materials. Clearances may be reduced in accordance with manufacturer's UL listing for fire-resistive duct wrap.
6. Provide approved access doors at changes of direction of kitchen exhaust ductwork.

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Provide nameplate of suitable material on access doors stating "ACCESS NOT OBSTRUCT". Install access doors on top or sides of duct; in horiz locate opening above the bottom of the duct to form a grease dam.

7. Provide mechanical sealing adapter by Ansul Fire Protection (or equal by access by balancing contractor for balancing hood system. Coordinate si sealing adapter with balancing contractor. Provide cap for adapter when Install mechanical sealing adapter in exhaust ductwork as close to exhaust fan as possible.

3.2 SCHEDULES

A. Ductwork Material Schedule

AIR SYSTEM	MATERIAL
Low Pressure Supply (Heating Systems)	Galvanized Steel
Low Pressure Supply (System with Cooling Coils)	Galvanized Steel
Return and Relief	Galvanized Steel
General Exhaust	Galvanized Steel
Kitchen Grease Hood Exhaust	Steel
Outside Air Intake	Galvanized Steel

END OF SECTION 233113

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SECTION 233300 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Dampers:
   1. Backdraft Dampers.
   2. Volume Control Dampers.

B. Duct Access Doors.

C. Duct Sleeves, Prepared Openings and Closure Collars.

D. Duct Test Holes.

E. Flexible Duct Connections.

F. Roof Curbs.

G. Turning Vanes.

H. Kitchen Exhaust Hoods.

I. Kitchen Hood Fire Extinguishing Systems.

1.2 RELATED SECTIONS

A. Division 23 Section "Identification for HVAC Piping and Equipment."

B. Division 23 Section "Instrumentation and Control for Mechanical Systems."

C. Division 23 Section "Metal Ducts."

D. Division 26 "Electrical": Electrical characteristics and wiring connections.

1.3 REFERENCES

A. ASTM C423-02a - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

B. ASTM E477-99 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

C. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

D. NFPA 92A - Smoke Control Systems.

E. NFPA 70 - National Electrical Code.

F. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from

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Commercial Cooking Equipment.

G. SMACNA - HVAC Duct Construction Standards - Metal and Flexible, Third E (HVACDCS).

H. SMACNA - Seismic Restraint Manual - Guidelines for Mechanical Systems (S

I. UL 33 - Heat Responsive Links for Fire-Protection Service.

J. UL 94 - Safety of Flammability of Plastic Materials for Parts in Devices and Appliances Testing.

K. UL 555 - Fire Dampers and Ceiling Dampers.

L. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems.

M. UL 1995 - Heating and Cooling Systems.

1.4 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.

C. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Closeout Procedures.”

B. Record actual locations of access doors and test holes.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years’ experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01 Section “Product Requirements.”

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B. Protect dampers from damage to operating linkages and blades.

PART 2 - PRODUCTS

2.1 GALVANIZED STEEL

A. Steel sheet metal components of accessories in this Specification Section shall be galvanized steel sheet, lock-forming quality, having G60 or heavier zinc coating conforming to ASTM A653 rating system and tested in accordance with ASTM A90. Provide paint-grip exterior surfaces for exposed ducts, where available.

2.2 DAMPERS

A. Manufacturers:
1. Ruskin.
2. Air Balance, Inc.
3. Arrow.
4. Cesco.
5. Greenheck.
6. NCA.
7. Tamco.
8. Ventex.
9. Vent Products, Inc.
10. No substitutions.

B. Backdraft Dampers:
1. Gravity Backdraft Dampers, Size 18 x 18 inches (450 x 450 mm) or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.
2. Multi-Blade, Parallel Action Gravity Backdraft Dampers: Frames of 16 ga (1.5 mm) thick galvanized steel, or extruded aluminum, with blades of maximum 6 inch (150 mm) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball or sintered bronze bearings, and plated steel pivot pin; [adjustment device to permit setting for varying differential static pressure.] Pressure and velocity ratings shall be suitable for the application.

C. Volume Control Dampers:
1. Factory-fabricate in accordance with SMACNA HVACDCS, and as specified or as indicated on the Drawings.
2. Shop fabrication is permitted for single blade dampers [and splitter dampers] only.
3. Height is the dimension perpendicular to the blade rod or shaft. Width is the dimension parallel to the blade rod.
4. Single Blade Dampers: For duct sizes (height x width) up to 7 x 30 inch (175 x 760 mm). When height or width exceeds its respective maximum, provide multi-blade damper.
5. Multi-Blade Damper: Opposed blade pattern with maximum blade sizes (height x width) 8 x 72 inch (200 x 1825 mm). Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
6. End Bearings: Except in round ductwork 6 inches (150 mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings. Provide retainer clips or other devices to prevent bearings from pulling out.

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For single-blade dampers, plastic bearings are allowed.

a) Manufacturers:
   1) Duro Dyne.
   2) Elgen Manufacturing.
   3) Rossi.
   4) Ventfabrics.

b) Snap-in Plastic Bearings for Single-Blade Dampers: Designed to push into hole in sheet metal, with retaining tabs. Flame Retardant, Glass Reinforced, "Zytel" polymer by Dupont, conforming to UL 1995 and UL 94 with the required flammability rating of 5VA or lower. Acceptable materials include Polyamide 66 (PA66) (glass-reinforced Dupont Zytel), nylon and acetyl. Submit manufacturer's verification of the suitability of these bearings for the application, including operating pressures and temperatures.

7. Quadrants:
   a) Manufacturers:
      1) Duro-Dyne.
      2) Elgen Manufacturing.
      3) Rossi.
      4) Ventfabrics.
   b) Duro-Dyne Specline SR and SRH series; Quadline series; or Stampline dial regulators and wedge-loc regulators. Or equal by Elgen, Rossi, or Ventfabrics. Factory-manufactured dampers shall have damper manufacturer's choice of quadrant equal to the Duro-Dyne products specified.
   c) Provide locking, indicating quadrant regulators on single and multi-blade dampers. Regulators shall include lever handle, locking wing nut and graduated indicator dial. Provide shaft seals, bushings, or gaskets for duct penetrations. Quadrants without these features are not allowed.
      1) Rossi Everlock Regulators: Locking lever handle of Polyamide 66 (PA66) (glass-reinforced Dupont Zytel) plastic, thumb trigger with stainless steel spring, with at least 9 latching positions in a 90 degree rotation.
   d) On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters, with open space to run insulation through.
   e) Where rod lengths exceed 30 inches (750 mm) provide regulator at both ends, with a single rod so that either regulator will control the entire damper.
8. Provide required operating wrenches for balancing, and furnish to the Owner at project completion.

2.3 DUCT ACCESS DOORS

A. Manufacturers:
   1. Standard Doors:
      a) Ruskin.
      b) Air Balance, Inc.
      c) Arrow.
      d) Buckley Associates.
      e) Cesco.
      f) DuctMate.
      g) Greenheck.
      h) Nailor.
      i) Vent Products, Inc.
      j) Shop fabricated.

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2. Grease Duct Doors:
   a) Ductmate.
   b) Shop fabricated.

B. Fabricated in accordance with SMACNA HVACDCS, and as specified or as in Drawings. Standard access doors and access doors for grease ducts may be sho Pressure rating shall be equal to the rating of the associated ductwork; see Part 3 Division 23 Section "Metal Ducts" for schedule of pressure classes.

C. Standard Doors: Removable, with retainer chain. Rigid and close-fitting with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum 1 inch (25 mm) thick insulation with galvanized steel sheet metal airstream-side cover.
   1. 16 inches (406 mm) Square and Smaller: Secure with two sash locks.
   2. Over 16 inches (406 mm), up to 24 inches (610 mm) Square: Provide four sash locks.
   3. Larger Sizes: Hinges and two compression latches with outside and inside handles.
   4. Clamping-type doors with knob handles, as manufactured by Ductmate, may be substituted for standard sizes.
   5. Material: Galvanized steel in galvanized steel ductwork. Stainless steel in stainless steel ductwork. Aluminum as manufactured by Arrow in aluminum ductwork.
   6. Provide in negative-pressure systems, and in positive-pressure systems with specified pressure class at or below 2 in. WG (498 Pa).

D. Medium- and High-Pressure Positive-Pressure Ducts:
   1. Ruskin ADHP-3 high pressure access door rated up to 12 in. WG (2985 Pa), with spring latches to allow the door to open temporarily to relieve negative pressures.
   2. Provide in positive-pressure systems with specified pressure class above 2 in. WG (498 Pa).

E. Access Doors For Grease Duct Applications:
   1. Shop-fabricated:
      a) Material to match duct.
      b) High-temperature ceramic gasket, suitable for at least 1500 degrees F (815.6 degrees C).
   2. Ductmate Industries, Inc. HI-TEMP access door, or approved equal.
      a) 16 gage (1.61 mm) black iron backing plate.
      b) High temperature ceramic gasket, 2300 degrees F (1260 degrees C) maximum.
      c) Zinc plated conical springs, zinc coated wing nuts and zinc plated carriage bolts.
   3. Ductmate Industries, Inc. ULtimate or ULtimate II access door.
      a) UL 1978 Listed.
      b) UL label and "Do Not Obstruct" label.
      c) 2 layers of 11 gage metal (provide black iron (carbon steel) or Type 304 stainless to match ductwork).
      d) High temperature ceramic gasket, 2300 degrees F (1260 degrees C) maximum.
      e) The ULtimate door is sandwich style, and requires no welding and special tools, but requires extra duct size.
      f) The ULtimate II door has a welded frame, and is available with or without a piano hinge.
      g) Collapsible loop handle welded to outer door.
      h) Corner thumb bolts. ULtimate door has studs with wingnuts welded to inner door.
      i) Can be used with high temperature insulation.
   4. For factory-manufactured round grease ducts, access doors may be furnished by the duct

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manufacturer. For double-wall ducts, access doors shall include inner an steel and inner layer of insulation.

5. Duct openings in horizontal ducts shall be above the bottom of duct to fo dam.
6. Meet NFPA 96 requirements for use in grease duct systems.

F. Access doors with sheet metal screw fasteners are not acceptable.

G. Sizing: Select sizes to allow testing, service, and maintenance within the ductwork. Such access may require the insertion of one or both hands, arms, and shoulders as appropriate. Doors sized for viewing-only are not acceptable. Doors found to be of inadequate size shall be replaced with proper size.

2.4 DUCT SLEEVES, PREPARED OPENINGS AND CLOSURE COLLARS

A. Duct Sleeves and Closure Collars: Fabricate from minimum 20 ga (1.0 mm) galvanized steel or equivalent thickness of aluminum, select material to match duct material. Where sleeves are installed in bearing walls, provide structural steel sleeves.

B. Prepared Openings: Provide 1 inch (25.4 mm) clearance between the duct and the sleeve.

2.5 DUCT TEST HOLES

A. Manufacturers:
1. Ductmate.
2. Carlyle Corporation.
3. Duro-Dyne.
4. Ventfabrics.

B. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

C. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.6 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:
1. Ductmate.
2. Ventfabrics.
3. Duro-Dyne.
4. No substitutions.

B. Fabricate in accordance with SMACNA HVACDCS, and as specified or as indicated on the Drawings.

C. Connector: Fabric crimped into metal edging strip.
1. Connectors shall be Ductmate PROFLEX Commercial series.
2. Fabric: UL listed coated woven glass fiber fabric meeting the requirements of NFPA 90A and NFPA 701. Resistant to weather and most chemicals, fat, grease, and oil.
   a) Supply Ducts: Neoprene coated, minimum density 30 oz per sq yd (1.0 kg/sq m).

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Fire-retardant coating. Black color. Temperature range -40 to 20(
(-40 to 93 degrees C).

b) Exhaust Ducts Serving Fume Hoods: Hypalon coated, minimum c
sq yd (0.8 kg/sq m). Flame proof coating. White color. UV and c
Temperature range -40 to 250 degrees F (-40 to 121 degrees C).

3. Net Fabric Width: Approximately 3 inches (75 mm) wide.
4. Metal: 3 inch (75 mm) wide, 24 ga (0.6 mm thick).
   a) Supply Ducts: G-60 galvanized steel.
   b) Exhaust Ducts Serving Fume Hoods: Type 316 stainless steel.
5. Connectors shall have double fold seams. Single fold seams (metal folded once only) shall not be accepted.

2.7 ROOF CURBS

A. Manufacturers:
   1. Greenheck.
   2. Acme Engineering and Manufacturing Corp.
   3. Loren Cook.
   4. Thybar Corporation.

B. For miscellaneous duct applications requiring roof curbs which are not specified with equipment in other Sections, provide curbs as specified in this Section.

C. Construction: Galvanized steel or aluminum, with continuously welded seams, 1-1/2 in. (38 mm) thick rigid fiberglass insulation with 3.0 lb/cu.ft (48 kg/m3) density and coated for airstream exposure, base flashing flange at least 1-1/8 in. (38 mm) wide, and factory installed wood nailer strip installed with notched and lapped joints for strength. For curbs where duct is not continuous thru the curb (such as curbs with sound baffles), provide metal liner to keep the wood nailer out of the airstream. For curbs with hot ducts where clearance to combustibles is a concern, wood nailer may be omitted.

D. Height: For installations where base of curb is under the roof insulation, curb shall be 16 inch (400 mm) high (unless otherwise indicated or specified) with built-in cant strips. For installations where base of curb is not under any roof insulation (but may be under thin roof finish material such as membrane, shingles, or metal roofing), curb shall be at least 12 inch (300 mm) high (unless otherwise indicated) with no cant strips.

E. Pitched Roof Curbs: Curbs for pitched and double-pitched roofs shall have base with built-in slopes to match roof pitches. Height of these curbs shall be at least the height specified above, measured at the highest point on the sloped base.

F. Curb Seal: Provide rubber curb seal for installation between curb and equipment.

2.8 SMOKE DETECTORS

A. Whether or not indicated on the Drawings, air handling systems operating at 2000 CFM and above shall have duct mounted smoke detection equipment in accordance with the requirements of NFPA 90A and BOCA.

B. Provide ionization type smoke detectors, duct mounted, universal voltage 120V AC, 24V DC, with sampling tube extending full width of duct.

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C. Wire contact to shut down respective fans and remotely initiate alarm in existin panel upon detection of smoke.

D. Provide a wall mounted test station which shall permit remote reset of alarms ai indication of alarm conditions.]

2.9 TURNING VANES

A. Manufacturers for Turning Vanes and Vane Rails:
   1. Ductmate Industries - PROrail 2 inch Turning Vane Rail.
   2. Duro Dyne - Junior Vane Rail.
   3. Hardcast, a division of Carlisle Corporation - Dyn-O-Rail Jr.

B. Factory-fabricated and factory-or-field-assembled units consisting of curved turning vanes for uniform air distribution and change of direction with minimum turbulence and pressure loss. Provide curved single thickness vanes for mitered elbows with change in direction of 45 degrees or greater, conforming to SMACNA HVACDCS single vane schedule for small vanes. Each vane shall form a 90 degree arc. Fill the entire duct cross-section with vanes. Orient leading edge of vanes parallel to the side of the duct (directed straight into the entering airstream).

C. Turning vanes shall be minimum 16 gauge (1.61 mm), regardless of gauges that are recommended by SMACNA. Double thickness turning vanes are not allowed.

D. Turning vanes in rectangular ductwork and shop-fabricated round ductwork shall conform with details on the Drawings. If not detailed, the SMACNA detail for small-radius small-spacing single-thickness vanes shall be used.

E. Turning vanes in manufactured round and flat oval duct elbows shall be the duct manufacturer's standard size, spacing, and gauge, but must be single-wall and not less than 16 gauge (1.61 mm).

F. Factory-fabricated turning vane rails shall be a minimum of 24 ga (0.7 mm) galvanized steel.

G. Material for vanes and rails shall be the same as the duct sheet metal.

2.10 EXHAUST HOODS - KITCHEN GREASE TYPE

A. Manufacturers
   1. Captive Aire
   2. Greenheck.
   3. GreaseMaster
   4. Halton.

B. Hood Types: UL 710 Listed, Type I for grease-laden vapors, with NSF seal of approval. Style as indicated on the Drawings, including exhaust-only, exhaust with integral makeup air supply, wall-mounted canopy type, island canopy type, and backshelf type.

C. Hood Construction:
   1. Hood shall be constructed of a minimum of 18 ga (1.31 mm), type 304 stainless steel with #4 finish.

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2. Hood shall be constructed using the standing seam method for optimum s
3. Seams, joints, and penetrations of the hood enclosure that direct and capt vapors and exhaust gases shall have a liquid-tight continuous external we lower outermost perimeter. Exposed external welds shall be ground and match the original finish of the metal.
4. Construction shall include corrosion-resistant steel framing members for Unexposed interior surfaces shall be constructed of a minimum 18 gauge (1.31 mm) corrosion-resistant steel.
5. Filter Housing: Integral to the hood, constructed of the same material as the hood. Filters shall be in sufficient numbers and sizes to ensure optimum performance as specified as the filter manufacturer. The filter housing shall terminate in a pitched, full length grease trough which shall drain into a removable grease drawer. Filters shall be installed at an angle not less than 45 degrees from the horizontal.
6. Filters: Stainless steel. UL classified or listed in accordance with UL Standard 1046. Filter grease particle collection efficiency shall be tested to ASTM Standard F2519-05 by an independent third party. Submittals shall include the third-party test results.
   a) Single-Stage High-Efficiency Baffle Filters: Rated grease-extraction efficiencies at particle sizes as follows: At least 50 percent at 5 microns (0.005 mm).
      1) Greenheck Hoods: GX Grease-X-Tractor filters
      2) CaptiveAire Hoods: Captrate Solo filters.
      3) Gaylord Hoods: XGS filters.
      4) Halton Hoods: KSA filters.
7. The hood shall be constructed as UL listed and shall be built in accordance with NFPA bulletin #96, ICBO, BOCA, SBCCI, and shall bear the NSF seal of approval. The exhaust airflow shall be based on the thermal updrafts produced by the cooking equipment and calculated by using the thermal updraft velocity method. The hood manufacturer shall provide, on request, the necessary data that confirms compliance with the above mentioned code authorities (NER report required).
8. Hoods shall extend a minimum of 6 inches (152 mm) beyond the sides of the equipment and 12 inches (300 mm) over the front of the equipment.
9. Stand-Offs:
   a) Provide hood with integral 3 inch (77 mm) stand-offs to maintain clearance from limited combustible materials as required by NFPA 96. Provide on back, sides, and top as required.
   b) Most hood manufacturers have a UL Listing on rear stand-offs which taper toward the bottom edge. Where local Authority requires, the stand-off shall provide a full 3 inch (77 mm) air space to the bottom edge of the hood. Contractor shall verify requirements with the local Authority.

D. Accessories:
1. Enclosure Panels: Where required, the hood manufacturer shall provide panels constructed of the same steel as the exposed hood surfaces. A mounting clip shall be factory welded to the top of the hood to accommodate field installation of enclosure panels. Panels shall be sized to extend from the top of the hood to 2 inches (50 mm) above the drop ceiling.
2. End and Back Panels: Where indicated, the hood manufacturer shall provide panels constructed of the same steel as the exposed hood surfaces. The panels shall extend from the bottom edge of the hood downward, to reduce interference from drafts. Panels shall be rear quarter style, or full style, as indicated. Provide mounting hardware.
3. Lights: Vaporproof, UL listed incandescent light fixtures shall be prewired to a junction box situated at the top of the hood for field connection. For fluorescent type, provide

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ballasts as required. Wiring shall conform to the requirements of the Nat
Code (NEC #70 - Latest Edition).

4. Provide each hood with a master electrical panel which shall consist of o
motor, a main disconnect switch, terminal block wiring and control circu
contained in a NEMA 1 enclosure.
5. CaptiveAire Fully Modulating Energy Management System (Variable-Sp
Control): Provide a system of heat sensors, variable-frequency drives, NEMA 1
enclosure, and accessories, to start the fan whenever heat is detected under the hood and vary the fans' speeds in response to the temperature. Setpoints (high and low speeds, fan activation and high-speed temperatures, and ramp rate) shall be full adjustable. Associated fan wall switch for the user shall be an On-Auto type to allow automatic operation. System shall be ETL listed and in conformance with International Mechanical Code requirements for automatic fan operation.]
6. MeLink System: ...Includes heat detection and visible smoke detection...]
7. Fan and Light Switches: Provide with stainless steel wall plate with identifying lettering. Ship loose for field mounting on wall at accessible height.

E. Fire Protection Systems: See paragraph 2.2 Kitchen Exhaust Hood Fire Extinguishing Systems in Part 2 of this Section.

2.11 KITCHEN EXHAUST HOOD FIRE EXTINGUISHING SYSTEMS

A. Manufacturers
1. Ansul - R-102 system and Ansulex liquid suppressant.
2. Amerex - KP system and KP liquid suppressant.
3. Kidde - WHDR system and APC wet chemical agent.
4. No substitutions.

B. Hood Fire Extinguishing System:
1. The hood shall contain an Ansul R-102 wet chemical fire suppression system. The system shall be properly sized for the duct, plenum and appliances. The system shall be completely installed by factory trained personnel. Field hook-up shall be subcontracted to an authorized factory representative and shall be performed after hood installation.
2. The installation shall be in accordance with UL listing and conform to local and state codes and standards, including NFPA 17A and U. L. Standard 300, November 1994.
3. Materials:
   a) Liquid Extinguishing Agent: Ansulex Low-PH Liquid Fire Suppressant, or Kidde APC wet chemical agent.
   b) Cylinders shall be manufactured, tested and marked in accordance with DOT Specifications. Charge with liquid extinguishing agent and pressurize with nitrogen. Provide suitable brackets for mounting.
   c) Piping shall be Schedule 40, black steel with malleable iron fitting. Discharge nozzles shall be of the proper design for the intended use (duct nozzle, plenum nozzle, appliance nozzle) and orifices shall be protected with appropriate seals.
4. Controls:
   a) System activation shall be by fusible link connected to automatic release or manual pull station. Controls for automatic operation and manual release shall be mechanical in design, using fusible metallic links, stainless steel cabling, corner pulleys and manual pull-station. Provide a pressure release device for automatic opening of the cylinder valves. Manual pull station shall be mounted where indicated, in the main path of egress, 42-48 inches above the floor, 10-20 feet from

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the hood.

b) Provide relays to shut down under-hood cooking appliances and ac building fire alarm system. Relays for interface with fire alarm sy suitable for use in supervised systems. Wiring to this equipment tl devices is included in the Electric Section of these Specifications. Owner in the operation and maintenance of the system.

c) Gas fuel sources and electrical power sources to equipment under the hood must be shut off on system activation. Provide a mechanical gas valve (coordinate with Plumbing Drawings for correct size).

d) Exhaust fan shall continue to run during extinguishing system operation.

e) Pull device shall be located next to exit from space. Pull device shall be fully recessed in wall and conduit shall be concealed.

5. Coverage: Provide nozzles to protect the hood and exhaust duct. Provide appliance-protection nozzles, distributed to protect the appliances indicated on the Contract Drawings.

6. Tests:

a) Provide factory-authorized technicians for startup and testing services.

b) A start-up test is required. Submit copies of the test records for approval.

c) Perform tests and submit certificates of approval as required by local officials. Also submit manufacturer's report certifying final inspection and system test.

2.12 UNIFORMITY OF MATERIALS

A. Ductwork accessories, including but not limited to volume dampers, smoke dampers, fire dampers, combination fire/smoke dampers, backdraft dampers and motorized dampers, shall be fabricated of materials that are similar to the ductwork in which they are installed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVACDCS. Refer to Division 23 Section “Metal Ducts” for duct construction and pressure class.

B. Install components furnished under other Section and Divisions of the Specifications. Such items may include but are not limited to: Sensors and airflow measuring stations furnished under Division 23 Section “Instrumentation and Control for Mechanical Systems”; gauges and meters; and smoke detectors furnished under Division 26 – Electrical.

C. Provide duct access doors in horizontal return air, exhaust air and fresh air intake ductwork to facilitate the removal of accumulations of dust and combustible materials in accordance with NFPA 90A. Install access doors at maximum 20 foot (6 m) intervals and at the base of each vertical riser.

D. Provide duct access doors for inspection, servicing, and cleaning before filters, before and after

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coils, before and after fans, before automatic dampers, at fire dampers, at smok combination fire and smoke dampers, at smoke detector sampling tubes (upstre sampling tube), at multiple blade volume dampers, at backdraft and counterbala and elsewhere as specified or as indicated on the Drawings. Provide at changes kitchen exhaust ductwork and as otherwise required for cleaning kitchen exhau accordance with NFPA 96. Provide minimum 8 x 8 inch (200 x 200 mm) size 1 18 x 18 inch (450 x 450 mm) size for shoulder access, and as specified or as indicated on the Drawings. Review locations prior to fabrication.

E. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

F. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

G. For volume dampers located above suspended ceilings and in areas that are not visible to building occupants (e.g. mechanical rooms), provide fluorescent orange colored surveyor's tape. Permanently attach tape to damper handles and run tape down to 10 in. (254 mm) above ceiling or 12 in. (304 mm) below damper handle where ceilings do not exist (e.g. mechanical rooms).

H. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and support by vibration isolators. Staple and seal connections airtight.

I. Duct Sleeves and Prepared Openings: Install for ducts passing through roofs, ceilings, walls and floors. Field determine the proper size and location of sleeves and prepared openings.
   1. Duct Sleeves: Allow one-inch (25 mm) clearance between duct and sleeve or one-inch (25 mm) clearance between insulation and sleeve for insulated ducts, except at grilles, registers, and diffusers.
   2. Prepared Openings: Allow one-inch (25 mm) clearance between duct and opening or one-inch (25 mm) clearance between insulation and opening for insulated ducts, except at grilles, registers, and diffusers.

J. Closure Collars:
   1. Provide not less than 4 inches (100 mm) wide on each side of walls or floors where sleeves or prepared openings are installed. Fit collars snugly around ducts. Grind smooth edges of collar to prevent tearing or puncturing insulation covering or vapor barrier.
   2. Where insulated ducts penetrate non-fire-rated walls, insulation shall be continuous through the closure collars and the closure collars shall be installed tight to the insulation.
   3. Where insulated ducts penetrate fire rated walls, insulate ducts on both sides of closure collars and seal points of contact between closure collar and insulation with vapor proof adhesive.
   4. Where ducts penetrate fire rated walls, provide fire proof sealant at closure collar. Refer to Division 07 Section "Through Penetration Firestop Systems," for fire proof sealant requirements.
   5. Secure closure collars to ducts with sheet metal screws at maximum 6 inch (152 mm) centers and secure closure collars to walls or floors with sheetrock screws, nails or other appropriate fastener at maximum 6 inch (152 mm) centers.
   6. Packing: Pack with non-combustible glass fiber insulation in spaces between

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sleeve/opening and duct/duct insulation. Cover or seal edges of packing fibers.

K. Duct Hangers and Supports: SMACNA HVACDCS, Section 4. Hang ducts up including 36 inches (914 mm) in width by a minimum of 1 in x 16 ga (25 mm x straps on each side of the duct on 4 ft (1.22 m) centers, bent under bottom of du 2 inches (50 mm) and securely fastened to duct. Hang ducts larger than 36 inches (914 mm) in width by 3/8 inch (9.5 mm) steel rods and 2 x 2 x 1/4-inch (50x50x6.3 mm) steel angle trapeze hangers, spaced 4 ft (1.22 mm) on center. [Provide seismic restraint complying with SMACNA SRMGMS.] Anchor risers in the center of the vertical run to allow ends of riser free vertical movements. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing member, provide suitable intermediate metal framing. [Where C clamps are used, use retainer clips.]

1. Flexible Ducts: Support ducts by hangers every 3 feet (0.9 m), unless supported by ceiling construction. Stretch flexible air ducts to smooth out corrugations, and long radius elbows, where possible, using a minimum length to make connections.
2. Flexible Connectors: Provide flexible connectors between fans and ducts or casings and where ducts are of dissimilar metals. For round ducts, securely fasten flexible connectors by zinc-coated steel clinch-type draw-bands. For rectangular ducts, lock flexible connectors to metal collars.
3. Ducts with Extra Weight Such As Lead Lining or Lagging: Include the extra weight in determination of suitable hangers and supports.

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SECTION 233400 – HVAC FANS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Centrifugal Fans:
   1. Upblast Centrifugal Roof Exhaust Fans for Kitchen Hood Exhaust.

B. Power Ventilators:
   1. Ceiling Exhaust Fans.

1.2 RELATED SECTIONS

A. Division 23 Section "Common Motor Requirements for HVAC Equipment."

B. Division 23 Section "Duct Insulation."

C. Division 23 Section "Metal Ducts."

D. Division 23 Section "Air Duct Accessories": Backdraft dampers.

E. Division 23 Section "Instrumentation and Controls for Mechanical Systems": Sequence of Operation.

F. Division 26 "Electrical."

1.3 REFERENCES

A. Division 01 Section "Quality Requirements."

B. ANSI/ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

C. ANSI/ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

D. AMCA 99 - Standards Handbook.

E. AMCA 210 - Laboratory Methods of Testing Fans for Rating.

F. AMCA 261 - Directory of Products Licensed to Use the AMCA Certified Ratings Seal.

G. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

H. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

I. NEMA MG1 - Motors and Generators.

J. NFPA 70 - National Electrical Code.

K. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

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L. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Va
Commercial cooking Equipment.

M. UL 705 - Power Ventilators.

N. UL 762 - Power Roof Ventilators For Restaurant Exhaust Appliances.

1.4 SUBMITTALS

A. Division 01 Section "Submittal Procedures."

B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

C. Shop Drawings: Indicate assembly of fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Division 01 Section "Closeout Procedures": Procedures for submittals.

B. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years experience.

1.7 REGULATORY REQUIREMENTS

A. [Kitchen Grease Hood Exhaust Fans: Comply with requirements of NFPA 96.]

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section "Product Requirements": Transport, handle, store, and protect products.

B. Protect motors, shafts, and bearings from weather and construction dust.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section "Product Requirements": Environmental conditions affecting products on site.

B. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test-run under observation.

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PART 2 - PRODUCTS

2.1 ELECTRONICALLY-COMMUTATED (EC) MOTORS - ALSO KNOWN AS DC (BFDC)

A. Manufacturers:
   1. Greenheck Fan Corporation - "Vari-Green" motor.
   2. General Electric.
   3. Twin City Fan Co.

B. Applications: Ceiling and cabinet fans, centrifugal inline fans, centrifugal roof exhaust fans, and centrifugal upblast exhaust fans, in sizes up to 3/4 hp (0.56 kW). Voltage 115V/1ph/60Hz.

C. See Division 23 Section "Common Motor Requirements for HVAC Equipment" for general requirements.

D. Speed Control:
   1. Typical motor speed range is 350 RPM to 1725 RPM.
   2. Motor operates on a voltage signal of 2-10 VDC, with 15-20 percent speed at 2V and 100 percent speed at 10V. Motor is switched off when the signal is 0-1.9 VDC.
   3. Control method furnished with the motor shall be one of the following, as indicated on the Drawings or in the Specifications:
      a. Motor-mounted potentiometer with screwdriver setting. Provide this unless otherwise indicated or specified.
      b. Remote-mounted Belimo potentiometer with calibrated 0-100 percent dial. Potentiometer includes a toggle switch to select an output range of 0-10V or 2-10V, so that with the 0-10 V setting the control can turn the fan off. Factory-mounted 24 VDC transformer in a junction box.
      c. Factory-furnished circuitry to accept a 0-10V signal from the building control system. Requires an additional 24 VDC power supply to the motor's controls, 0.70 VA capacity.
   4. Provide field-furnished metal 2 x 4 in. (50 x 100 mm) junction box for mounting remote potentiometer dials.
   5. Provide field-furnished interconnecting power and control wiring as required, including separate flexible conduits for line-voltage and low-voltage wiring.]

2.2 UPBLAST CENTRIFUGAL ROOF AND WALL EXHAUST FANS FOR KITCHEN HOODS

A. Manufacturers:
   1. Captive Aire.
   2. Acme.
   3. Loren Cook.
   4. Greenheck.
   5. Penn Barry.
   6. Twin City Fan Co.

B. Description: The exhaust fan shall be supplied by the hood manufacturer. The fan shall be belt or direct driven, as scheduled on the Drawings. Base shall be reinforced aluminum construction. Fan housing shall be heavy-duty spun aluminum. The motor compartment shall be isolated and forced cooled by air drawn from outside the fan through breather tubes. The

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fan shall be U. L. rated under Standard 762 for grease laden vapors. The motor continuous duty type with shielded ball bearings. Belt drives shall be the adjus V-belt type.

C. Performance:
   1. Performance Ratings: Conform to AMCA 210 and bear the AMCA Cert Seal.
   2. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
   3. Fabrication: Conform to AMCA 99.
   4. Performance Base: Sea level conditions.
   5. Temperature Limit: Maximum 300 degrees F (150 degrees C)
   6. Static and Dynamic Balance: Eliminate vibration or noise transmission to occupied areas.

D. Wheel and Inlet: Backward inclined, aluminum construction with smooth curved inlet, backwardly curved blades, cast aluminum hub keyed to shaft with set screws.

E. Bearings and Drives:
   1. Bearings: Heavy duty cast iron pillow block type, self-aligning, grease-lubricated ball bearings, with ANSI/ABMA 9-rated L-50 life at least 200,000 hours at maximum catalogued operating speed.
   2. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated.
   3. Drive Frame Assembly: Heavy ga steel, mounted on vibration isolators.
   4. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 hp (11.2 Kw) and under, selected so required rpm is obtained with sheaves set at mid-position. Fixed sheave for 20 hp (15 Kw) and over. Matched belts. Drive rated as recommended by manufacturer, with minimum 1.5 times nameplate rating of the motor.

F. Grease Trough: Provide integral trough at base of housing.

G. Hinged Subbase: Provide with flexible weatherproof electrical cable and service hold-open retainer to permit proper inspection and cleaning.

H. Compression Latches: Stainless steel, padlockable. Provide at least 2 on side of fan subbbase and curb opposite hinge, for ease of cleaning.

I. Roof Curb: Provide factory-fabricated roof curb with proper height (but in no case less than 18 inches (457 mm) high) to ensure 18 inch (457 mm) clearance from fan to combustibles and ensure that the fan discharges a minimum of 40 inches (1016 mm) above the roof surface.
   1. Curb shall be constructed of galvanized steel with no insulation or combustible materials, and shall incorporate a field-installed high-temperature non-combustible gasket around perimeter top, and be designed for installation on flat roof. Curb shall have ventilation openings where required by Code.
   2. Curb shall be installed, shimmed for roof pitch, leveled and flashed by Roofing Subcontractor.

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2.3 POWER VENTILATORS

A. Manufacturers:
   1. Greenheck.
   2. Acme.
   3. Hartzell.
   4. Loren Cook.
   5. Penn Barry.
   6. Twin City Fan Co.

B. Product Requirements:
   1. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
   2. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
   3. Fabrication: Conform to AMCA 99.
   4. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

C. Cabinet and Ceiling Exhaust Fans:
   1. Centrifugal Fan Unit: Centrifugal impeller, V-belt or direct driven as scheduled on the Drawings, with galvanized steel housing, resilient mounted motor, gravity backdraft damper in discharge.
   2. Grille: Molded white plastic
   3. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
   4. Vibration Isolation: Provide mounting brackets to accept rubber hangers as specified in Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment”. Vibration isolators furnished by the fan manufacturer are not allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Division 01 Section “Quality Requirements”: Manufacturer's instructions.

B. Install fans with resilient mountings and flexible electrical leads. Refer to Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

C. Secure roof fans with hex-head lag screws to roof curb, minimum of 2 screws on each side of fan, minimum 8 screws total. Screw threads shall be wood type or sheet metal type as appropriate, #12 (7/32 inch (5.6 mm) minimum sheet metal screw size, 3/16 inch (4.8 mm) shank minimum wood screw size. For aluminum fans with aluminum curbs, or steel curbs with wood nailers, use aluminum screws. For aluminum fans with steel curbs (without wood nailers, such as kitchen grease exhaust fans), use galvanized steel screws with rubber or plastic washers to isolate dissimilar metals. For steel fans with steel curbs, use galvanized steel screws.

D. Provide safety screen where inlet or outlet is exposed.

E. Provide backdraft dampers on discharge of exhaust fans and as indicated; refer Section "Air Duct Accessories"

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SECTION 233700 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Diffusers.

B. Registers/Grilles.

C. Brick Vents and Block Vents.

D. Louvers.

1.2 RELATED SECTIONS

A. Division 23 Section "Instrumentation and Controls for Mechanical Systems."

1.3 REFERENCES

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.

B. ADC 1062 - Certification, Rating and Test Manual.

C. AMCA 500 - Test Method for Louvers, Dampers and Shutters.

D. AMCA 511 - Certified Ratings Program for Air Control Devices

E. ARI 650 - Air Outlets and Inlets.

F. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

G. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

H. ASTM E413 - Classification for Rating Sound Insulation.

I. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

J. NFPA 70 - National Electrical Code.

K. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.4 SUBMITTALS

A. Submit under provisions of Division 01 Section "Submittal Procedures."

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets indicating type, size, application, rated airflow, noise level, pressure drop, and throw distance as applicable. Submit both manufacturer's standard performance tables and graphs, AND

tabulated selection data specific to this project. NOTE: Submittals without cor
sufficient information, to verify the performance specified and scheduled on the
be rejected.

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1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section "Closeout Procedures."

B. Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

B. Test and rate louver performance in accordance with AMCA 500.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years' experience.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Diffusers, Registers, Grilles, and Drum Louvers:
1. Titus.
2. Anemostat.
3. Krueger.
4. Metalaire.
5. Price.

B. Brick Vents and Block Vents:
1. Greenheck.
2. Airolite.
3. American Warming and Ventilating.
4. Arrow.
5. Ruskin.
6. United Enertech.

C. Louvers (Non-acoustical Type):
1. Greenheck.
2. Airolite.
3. American Warming and Ventilating.
4. Arrow.
5. Ruskin.
6. United Enertech.

D. No substitutions.

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2.2 WALL SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable blades, 3/4 inch (19 mm) minim 3/4 inch (19 mm) maximum spacing with spring or other device to set blades, v horizontal face as indicated, double deflection.

B. Frame: 1-1/4 inch (32 mm) margin with concealed mounting and gasket.

C. Fabrication: Steel with 20 gauge (0.90 mm) minimum frames and 22 gauge (0.80 mm) minimum blades, steel and aluminum with 20 gauge (0.90 mm) minimum frame, or aluminum extrusions, as indicated, with factory off-white enamel finish.

D. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.

E. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.3 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing, with blades set at 45 degrees, vertical or horizontal face as indicated.

B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting.

C. Fabrication: Steel with 20 gauge (0.90 mm) minimum frames and 22 gauge (0.80 mm) minimum blades, steel and aluminum with 20 gauge (0.90 mm) minimum frame, or aluminum extrusions, as indicated, with factory off-white enamel finish.

D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

E. Gymnasiums: Provide front pivoted or welded-in-place blades, securely fastened to be immobile.

2.4 SPIRAL DUCT SUPPLY REGISTERS

A. Type: Streamlined and individually adjustable blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing with spring or other device to set blades, vertical or horizontal face as indicated, double deflection. Radius end caps and foam gaskets sized to match the spiral duct for a tight seal.

B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket.

C. Fabrication: Aluminum with heavy-duty aluminum extrusions, with factory off-white enamel finish.

D. Damper: Integral, air scoop extractor type with removable key operator, operable from face.

2.5 BRICK VENTS AND BLOCK VENTS

A. Vents shall be one-piece cast #319 aluminum alloy. Nominal wall thickness shall be at least

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0.125 inches (3 mm). Blades shall be at 35 to 45 degree angle from horizontal. include integral water stop in frame, integral storm drip on each blade, and alun screen at inside face of blades. Free area of maximum size vent shall be at least

B. Finish: Factory baked enamel finish. Submit manufacturer's standard color ch Architect will select color.

2.6 LOUVERS (4-INCH)

A. Louvers shall be equal to, and shall have free areas no less than, Greenheck Model ESD-403. Acceptable substitutes by other listed manufacturers (subject to performance specified and scheduled on Drawings) shall be:
   1. Airolite: Model
   2. American Warming & Ventilating: Model LE-23.
   3. Arrow: Model EA-415-D.
   4. Ruskin: Model ELF445DX.

B. For reference, free area of a model ESD-403 in 48 inch x 48 inch (1.2 m x 1.2 m) size is 8.0 sq. ft (0.74 m2).

C. Free area velocity at beginning of water penetration shall be at least 1000 fpm (5.0 m/sec). Beginning of water penetration is defined by AMCA as 0.01 oz. per sq. ft (3 g/m2).

D. Air pressure drop for intake air at an air velocity of 1000 fpm (5.0m/sec) in intake mode shall not exceed 0.20 in.wg (49.8Pa).

E. Testing for water penetration and air performance shall be in accordance with AMCA Standard 511, using a 48 inch x 48 inch (1.2 m x 1.2 m) louver.

F. Type: 4 inch (100 mm) deep with drainable blades on approximately 37 to 45 degree slope, heavy channel frame, removable expanded aluminum bird screen with 1/2 inch (13mm) mesh mounted on interior face.

G. Fabrication: 0.081 inch (2.05 mm) thick 6063-T5 extruded aluminum alloy, welded assembly.

H. Mounting: Furnish with standard box frame and angles for installation.

I. Finish: Factory baked enamel finish. Submit manufacturer's standard color chart. The Architect will select color.

J. Louvers shall bear the AMCA rating seal for water penetration and air performance.

2.7 ROOF CURBS

A. Construction: Galvanized steel or aluminum, with continuously welded seams, 1-1/2 in. (38 mm) thick rigid fiberglass insulation with 3.0 lb/cu.ft (48 kg/m3) density and coated for airstream exposure, base flashing flange at least 1-1/8 in. (38 mm) wide, and factory installed wood nailer strip installed with notched and lapped joints for strength. For curbs where duct is not continuous thru the curb (such as curbs with sound baffles), provide metal liner to keep the wood nailer out of the airstream.

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B. Height: For installations where base of curb is under the roof insulation, curb s (400 mm) high (unless otherwise indicated or specified) with built-in cant strips installations where base of curb is not under any roof insulation (but may be un finish material such as membrane, shingles, or metal roofing), curb shall be at l (300 mm) high (unless otherwise indicated) with no cant strips.

C. Pitched Roof Curbs: Curbs for pitched and double-pitched roofs shall have base with built-in slopes to match roof pitches. Height of these curbs shall be at least the height specified above, measured at the highest point on the sloped base.

D. Curb Seal: Provide rubber curb seal for installation between curb and equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

C. Install outlets and inlets to ductwork with air tight connection.

D. Slope ducts or plenums at louvers, and at brick or block vents, to drain outward, and seal bottoms watertight.

E. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

F. Paint ductwork visible behind air outlets and inlets matte black. Refer to Division 09 Section "Painting."

G. Surfaces exposed to view shall be clean, and free of stains, smudges, and scratches.

H. Provide hex-head fasteners to curb in each hole in curb caps or bases of roof-mounted units. Provide protection between dissimilar metals.

END OF SECTION 233700

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SECTION 234100 – PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Disposable, Pleated-Media Extended Area Panel Filters.

1.2 RELATED SECTIONS

A. Division 01 Section "Temporary Facilities and Controls": Filters for temporary heating and ventilating.

B. Division 26 Section "Equipment Wiring": Electrical characteristics and wiring connections.

1.3 REFERENCES

A. ARI 850 - Commercial and Industrial Air Filter Equipment.

B. ASHRAE 52.2-2007 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

C. IEST - Recommended Practice IEST-RP-CC001.

D. ISO 14644-1 - Cleanrooms and Associated Controlled Environments.

E. MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components, and related Products: Performance-Test Methods.

F. NFPA 70 - National Electrical Code.

G. UL 586 - Test Performance of High Efficiency Particulate, Air Filter Units.

H. UL 867 - Electrostatic Air Cleaners.

I. UL 900 - Test Performance of Air Filter Units.

1.4 DEFINITIONS

A. MERV: Minimum Efficiency Reporting Value, in accordance with ASHRAE Standard 52.2.

B. MERV-A: Minimum Efficiency Reporting Value, in accordance with ASHRAE Standard 52.2 Appendix J, using an aerosol to neutralize electrostatic charge.

1.5 PERFORMANCE TOLERANCES

A. Conform to ARI 850 Section 7.4.

B. Particle Size Efficiency: Plus or minus 5 percent, relative to the ASHRAE 52.2-2007 rating standards.

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1.6 SUBMITTALS

A. Submit under provisions of Division 01 Section "Submittal Procedures."

B. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor l electrical characteristics and connection requirements.

C. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section "Operation and Maintenance Data."

B. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years experience.

1.9 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., as suitable for the purpose specified and indicated.

1.10 EXTRA MATERIALS

A. Furnish under provisions of Division 01 Section "Closeout Procedures."

B. Provide one set of filters.

PART 2 - PRODUCTS

2.1 GENERAL

A. Filter efficiency (MERV) ratings shall be in accordance with ASHRAE Standard 52.2-2007. Filter ratings shall incorporate particle size vs. efficiency.

B. Particulate Filters (other than electrostatic precipitators):
   1. Ratings shall be MERV-A in accordance with the Standard's Appendix J (part of Addendum B, approved in 2008), which requires a conditioning step using a KCl aerosol to neutralize electrostatic charge.
   2. If the manufacturer has not completed MERV-A testing, submittals shall include a statement that the filtration and MERV rating are entirely mechanical and does not rely on an electrostatic charge.
   3. Fine fiber media, which maintain their efficiency over time, are required, as opposed to coarse-fiber media which rely on electrostatic charge and lose efficiency over time as the charge dissipates.

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C. Gas-Phase filters such as activated carbon shall be rated for gas absorption, and MERV-rated prefilters.

2.2 MANUFACTURERS

A. Filters, Frames, and Housings:
1. Camfil Farr.
2. AAF International (American Air Filter and AAF brands).
3. Airguard - a Clarcor company.
4. Cleanrooms International (products: ceiling HEPA filter housings and fan-filter units).
5. Columbus Industries (product: Polysorb carbon filtration).
6. Eco-Air - division of Flanders Corporation.
7. Fiberbond Corporation.
8. Flanders Corporation.
9. GlasFloss Industries.
10. Purolator - a Clarcor company.
11. No substitutions.

B. Gauges:
1. Dwyer.

2.3 DISPOSABLE, PLEATED-MEDIA EXTENDED AREA PANEL FILTERS

A. Product: Camfil Farr 30-30.

B. Media: UL 900 Class 2, pleated, lofted, non-woven, reinforced cotton and synthetic fabric; supported and bonded to wire grid.
1. Frame: High-wet-strength beverage board.
2. Pleats: Rounded radial type for full usage of media area.
3. Nominal thickness: 2 inches (50 mm), unless otherwise indicated.

C. Performance Ratings:
1. MERV (ASHRAE 52.2): 8.
2. MERV-A (ASHRAE 52.2, Appendix J): 8.
3. Maximum Initial Resistance:
   a. At 350 Fpm (1.78 m/sec) Face Velocity:
      1) 1 inch thick (25 mm) Filter: 0.23 inch WG (77 Pa).
   b. At 500 Fpm (2.54 m/sec) Face Velocity:
      1) 2 inch thick (25 mm) Filter: 0.31 inch WG (77 Pa).
      2) 4 inch thick (50 mm) Filter: 0.27 inch WG (77 Pa).
4. Recommended Final Resistance: 1.0 inch WG (249 Pa).
5. Guaranteed Pressure Drop Without Failure: 2.0 inch WG (498 Pa).
6. Maximum Operating Temperature: 180°F (82°C) continuous, 200°F (93°C) intermittent.
7. Total Media Area, 24 inch x 24 inch (610 mm x 610 mm) Nominal Size:
   a. 1 inch (12.5 mm) Thick: 9.8 sq. ft (0.9 m^2).
   b. 2 inch (25 mm) Thick: 17.3 sq. ft (1.6 m^2).
   c. 4 inch (25 mm) Thick: 27.7 sq. ft (2.5 m^2).

PART 3 - EXECUTION

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3.1 INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.

B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene ga

C. Provide new filters in air handling systems immediately before the systems are balanced by the approved balancing contractor. Air handling systems shall be balanced with clean filters.

D. Do not operate fan system until filters (temporary or permanent) are in place. Once air handling systems are in operation and before substantial completion, provide filter replacement as required. Filters shall be replaced when their pressure drop (as measured by the approved balancing contractor) reaches the manufacturer's recommended changeout pressure drop. At the time of substantial completion, provide air handling systems with a new set of filters. After substantial completion, provide any air handling systems that are subjected to significant dust and debris as a result of continued construction with filter changeouts as specified above, and provide new filters when construction is completed.

END OF SECTION 234100

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SECTION 237333 – DIRECT-FIRED H&V UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged indoor units.

B. Heat Exchangers.

C. Unit controls.

D. Remote panel.

E. Roof mounting curbs and bases.

1.2 RELATED SECTIONS

A. Division 23 Section "HVAC Fans" – Kitchen hood exhaust fans.

1.3 REFERENCES

A. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.

B. NFPA 54 - National Fuel Gas Code.

C. NFPA 70 - National Electrical Code.

D. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

E. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

1.4 SUBMITTALS

A. Division 01 Section "Submittal Procedures."

B. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

C. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing. Submit in accordance with Division 01 Section "Operation and Maintenance Data."

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1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the Products specifiec with minimum 3 years' experience.

1.6 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section "Product Requirements": Transport, handle, store, and protect products.

B. Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.

1.8 WARRANTY

A. Provide a full parts warranty for 1 year from substantial completion.

B. Provide 5 year limited warranty for heat exchanger including materials only.

1.9 EXTRA MATERIALS

A. Division 01 Section "Closeout Procedures."

B. Provide 1 set of filters, in addition to the initial set.

PART 2 - PRODUCTS

2.1 MAKEUP-AIR UNITS

A. Approved Manufacturers:
1. Reznor.
2. Captive-Aire.
3. Greenheck
4. Modine
5. Sterling HVAC Products.
6. Trane.

B. Burner: The velocity of air over the burner must remain constant. Low & high air velocity safety pressure switches shall be provided to protect against low or high air flow over the burner. Burner shall be of cast iron with stainless steel mixing plates. Sight port shall be available for viewing burner and pilot flame.

C. Controls:
1. Gas safety controls shall be provided to meet (ANSI) (CSA) (FM) (GAP) requirements and will include a flame safeguard relay with flame sensor. (Provide high and low gas pressure switches.) Ignition shall be by a 24 volt electronically controlled hot surface intermittent ignition system with a ceramic igniter.

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2. Automatic and manual high temperature limits shall be provided at the di unit and a high temperature safety at the burner. Provide freezestat at the unit.
3. Provide adjustable, 0-100 deg F, outside air cutoff to shutoff gas when ou temperature exceeds 65 deg F.
4. Gas control shall be electronic modulation gas control discharge air temp (55-90 deg F). Includes discharge air sensor, amplifier, and remote manual temperature selector and control switch mounted on separate 4x4 boxes.

D. Cabinet: The double-wall cabinet shall be constructed of galvalume steel for high corrosion resistance. Insulation shall be 1", 1 lb. density. Discharge shall be horizontal. All gas and electrical controls shall be mounted in the control compartment with easily removable doors. All access panels and doors shall have pocket handles for ease of handling.

E. Motor: An open dripproof premium efficiency blower motor with adjustable drive.

F. Filter Section: Filters shall be easily accessible through a removable access panel.

G. Electrical: Internal electrical components shall be prewired for single point power connection. Electrical components shall be UL listed, recognized or classified where applicable and wired in compliance with the National Electrical Code. Control center shall include control circuit fusing, control transformer for 24 VAC circuit, integral disconnect switch, and terminal strip. Contactors, Class 20 adjustable overload protection, and single phase protection shall be included.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section "Project Management and Coordination": Verification of existing conditions prior to beginning work.

B. Verify that roof is ready to receive work and opening dimensions are as indicated on Shop Drawings.

C. Verify that proper power supply is available.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

C. Indoor Units:
1. Provide steel support frames and intermediate steel supports as indicated and as required.
2. Fasten floor-mounted units to floor slab or housekeeping pad as indicated.
3. Support suspended units with vibration isolators located at the tops of threaded hanging rods. Provide double nuts.

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D. Provide gas service connection in accordance with NFPA 54 and Division 22 Provide components in the following order: shutoff valve, sediment trap, unio furnished gas train.

E. Locate remote panels where indicated and as directed.

3.3 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Division 01 Section “Quality Requirements.”

B. Provide initial start-up and shut-down during first year of operation, including routine servicing and check-out.

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SECTION 238130 - VARIABLE-REFRIGERANT-FLOW AIR CONDITIONING SYST

PART 1 - GENERAL

1.1 DESCRIPTION

A. Variable capacity, variable refrigerant flow heat pump and air conditioning split systems.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years experience.

B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 3 years experience.

C. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

D. Wiring shall be in accordance with the National Electric Code (NEC).

E. The system shall bear the Energy Star label.

F. The system shall be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

G. The outdoor unit will be factory charged with R410A.

1.3 WARRANTY

A. Manufacturer’s warranty for a period of 1 year from date of installation. Limited labor warranty for a period of 1 year from date of installation. Compressor warranty: 6 years from date of installation. During the stated period, should any part fail due to defects in material and workmanship, it shall be repaired or replaced at the discretion of the manufacturer.

1.4 INSTALLATION REQUIREMENTS

A. The system must be installed by a factory-trained contractor/dealer.

1.5 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled according to the manufacturer’s recommendations.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Manufacturers:
   1. Panasonic.

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2. Daikin.
3. LG.
4. Mitsubishi.
5. Toshiba.
6. York, a division of Johnson Controls.

B. The variable capacity, heat pump shall consist of multiple evaporators using PID control, and one outdoor units. The direct expansion (DX), air-cooled heat pump air-conditioning system shall be have variable speed driven compressor multi zone split system, using R410A refrigerant. Indoor units are each capable of operating separately with individual temperature control.

2.2 OPERATING RANGE

A. The operating range in cooling will be 23°F DB ~ 115°F DB. The operating range in heating will be 0 degrees F DB – 64 degrees F DB / -5 degrees F WB – 60 degrees F WB.

2.3 REFRIGERANT PIPING

A. The system shall be capable of refrigerant piping up to 410 equivalent feet, a total combined length of 1000 feet of piping between the condensing and fan coil units with 165 feet maximum vertical difference, without any oil traps or additional equipment. In case where the outdoor unit is located below the indoor unit, the vertical difference is a maximum of 133 feet.

2.4 OUTDOOR UNIT

A. General: The outdoor unit is designed specifically for use with VRF series components.
1. The outdoor unit shall be factory assembled and pre-wired with necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of a compressor, motors, fans, condenser coil, electronic expansion valve, solenoid valves, 4 way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receivers and accumulators.
2. Both liquid and suction lines must be individually insulated between the outdoor and indoor units.
3. The outdoor unit can be wired and piped with outdoor unit access from left, right, rear or bottom.
4. The sound pressure dB(A) at rated conditions shall not exceed a value of 60 decibels at 3 feet from the front of the unit. The outdoor unit shall be capable of operating at further reduced noise during night time.
5. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for re-programming.
6. The outdoor unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
7. The following safety devices shall be included on the condensing unit; high pressure switch, control circuit fuses, crankcase heaters, fusible plug, high pressure switch, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers. To ensure the liquid refrigerant does not flash when supplying to the various fan coil units, the circuit shall be provided with a sub-cooling feature. Oil recovery cycle shall be automatic occurring 1 hour after start of operation and then every 6 hours of operation.

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B. Unit Cabinet:
   1. The outdoor unit shall be completely weather proof and corrosion resista slat spray environment. The unit shall be constructed from rust-proofed coated with a baked enamel finish.

C. Fan:
   1. The condensing unit shall consist of one propeller type, direct-drive fan motors that have multiple speed operation via a DC inverter.
   2. The condensing unit fan motor shall have multiple speed operation of the DC inverter type, and be of high external static pressure and shall be factory set as standard at 0.12 in. WG with available by field setting switch to a maximum 0.24 in. WG pressure.
   3. The fan shall be a vertical discharge configuration.
   4. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
   5. The fan motor shall be provided with a fan guard to prevent contact with moving parts.

D. Condenser Coil:
   1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
   2. The coil shall be of a waffle louver fin and high heat exchanger, rifled bore tube design to ensure highly efficient performance.
   3. The coils shall be complete with corrosion treatment of an acrylic resin type. The thickness of the coating must be between 2.0 to 3.0 microns.

E. Compressor:
   1. The scroll compressor shall be variable speed (PAM inverter) controlled which is capable of changing the speed to follow the variations in total cooling load as determined by the suction gas pressure as measured in the condensing unit.
   2. The inverter driven compressor in each condensing unit shall be of highly efficient reluctance DC, hermetically sealed scroll type with a maximum speed of 6,480 rpm.
   3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
   4. Each non-inverter compressor shall also be of the hermetically sealed scroll type.
   5. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
   6. Oil separators shall be standard with the equipment together with an oil balancing circuit.
   7. The compressor shall be mounted to avoid the transmission of vibration.

2.5 INDOOR UNIT

A. General: Indoor unit shall operable with refrigerant R410A, equipped with an electronic expansion valve. Computerized PID control shall be used to maintain room temperature within 1 degree F. The unit shall be equipped with a programmed drying mechanism that dehumidifies while inhibiting changes in room temperature when used with remote control. A mildew-proof, polystyrene air filter and condensate drain pan shall be included as standard equipment. The indoor units sound pressure shall range from 32 dB(A) to 38 dB(A) at low speed measured at 3.3 feet below and from the unit.

B. Indoor Unit:

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1. The indoor unit shall be completely factory assembled and tested. Includ factory wiring, piping, electronic proportional expansion valve, control c motor thermal protector, flare connections, condensate drain pan, self-dia restart function, 3-minute fused time delay, and test run switch. The unit auto-swing louver which ensures efficient air distribution, which closes a when the unit stops. The remote controller shall be able to set five (5) ste angle. The front grille shall be easily removed for washing. The discharge angle shall automatically set at the same angle as the previous operation upon restart. The drain pipe can be fitted to from either left or right sides.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. Return air shall be through a resin net mold resistant filter.
5. The indoor units shall be equipped with a condensate pan.
6. The indoor units shall be equipped with a return air thermistor.

C. Fan:
1. The fan shall be a direct-drive cross-flow fan, statically and dynamically balanced impeller with high and low fan speeds available.
2. The air flow rate shall be available in high and low settings.
3. The fan motor shall be thermally protected.

D. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 2 row cross fin copper evaporator coil with 15 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1 inch outside diameter PVC.
5. A thermistor will be located on the liquid and gas line.
6. A condensate pan shall be located in the unit.

E. Electrical:
1. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
2. Transmission (control) wiring between the indoor and remote controller shall be a maximum distance of 1,640 feet.

F. Control:
1. The unit shall have controls provided by the manufacturer necessary to operate the system.

PART 3 - INSTALLATION

3.1 EXAMINATION

A. Verify that system is located per Drawings.

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B. Verify that proper power supply is available.

3.2 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Provide recessed wall mounting box for mounting the wired indoor controller. Fasten the box to wall framing stud, masonry, or other suitable structural surface approved by the Architect; fastening to gypsum wallboard is not acceptable. Provide interconnecting low-voltage and line-voltage wiring and conduits, concealed unless otherwise indicated. Wall mounting box, wiring, and conduits shall be in accordance with the requirements of Division 26 – Electrical.

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SECTION 260010 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Electrical Requirements specifically applicable to all Division 26 Sections.

B. Intent Is to Provide and Install Complete Electrical Systems, as required to Accommodate the renovations to the existing Building.

C. Access Panels: Where required by NFPA 70 (N.E.C.)

D. All Cable Bundles Shall Be Limited to a Maximum of 12 Cables, Individual Bundles of Cables Shall Be Separated by at Least 2 Inches in All Directions.

1.2 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Examine all contract documents for requirements affecting the work.

1.3 DEFINITIONS

A. As used in this section, "provide" shall mean, "furnish and install". "Furnish" shall mean "to purchase and deliver to the project site complete with every necessary appurtenance and support", and "Install" shall mean "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project".

1.4 WORK BY OWNER

A. The Owner will award contracts for Technology equipment soliciting proposals from factory authorized vendors. Installation will occur during building construction. Purchase may include installation, wiring, testing and training. Cooperate and coordinate with successful vendors to allow for the installation to occur during construction. Systems which may be purchased include:
   1. Music / Sound System.
   2. Telephone / data / networking System.
   3. .

B. All wiring, connectivity, terminations and testing for complete systems.

1.5 SUBSTITUTIONS

A. Refer to Division 01 for Substitutions and Product Options.

1.6 REFERENCES

A. NEMA Standards.

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B. NECA "Standard of Installation."

C. NFPA 70 (N.E.C.) latest edition.

D. NFPA 101 Life Safety Code.

E. U.L. Standards.

F. ANSI Standards.

G. Maine Uniform Building and Energy Codes (MUBEC) which include provisions of:
   1. (IBC) International Building Code.
   2. (IEBC) International Existing Building Code.
   3. (IRC) International Residential Code.
   4. (IECC) International Energy Conservation Code.
   5. ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality.
   6. ASHRAE 62.2 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings.
   7. ASHRAE 90.1 Energy Standard for Buildings except Low-Rise Residential Buildings.
   8. ASTM E1465-06 Radon Standard for new residential construction - (Maine Model Standard).

1.7 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section “Submittal Procedures”.

B. Include products specified in Division 26 individual sections.

C. Submit Shop Drawings and product data grouped by individual Sections to include complete submittals of related systems, products, and accessories. Label each with Section number and title. Partial Section submittals will not be reviewed.

D. Include access panels.

E. Include fire-stop seals and fillers.

1.8 RECORD DRAWINGS

A. Submit under provisions of Division 01 Section “Project Management and Coordination”.

B. Keep a marked set of Drawings at the site as a record set indicating all revisions in the work as the work progresses. At the completion of the work, mark the Drawings "As-Built Drawings" with the Contractor's name and date, and deliver to the Architect.

1.9 PERFORMANCE REQUIREMENTS

A. Conform to requirements of the latest edition of ANSI/NFPA 70 National Electrical Code (N.E.C.).

B. Conform to requirements of all local, State and Federal laws and regulations, plus local electric utility company's rules, and the Fire Underwriters' requirements.

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C. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) purpose specified and shown.

D. Secure and pay for all permits and certificates as required by local, State and Fec

E. Request inspections from authority having jurisdiction.

F. Run separate circuits for lighting and receptacle outlets as indicated.
   1. Circuits shall be balanced and loads and capacities shall be in accordance with requirements of local electric light company and National Board of Fire Underwriters.
   2. Do not share neutral on branch circuits.

G. The entire electrical system shall be permanently and effectively grounded in accordance with Code requirements.

H. The Drawings indicate only diagrammatically the extent, layout and the general location and arrangement of equipment, conduit and wiring. Become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment will be properly located and readily accessible.
   1. Note that drawings do not show all junction boxes and fixture whips for lighting fixtures recessed in accessible ceilings. Although not specifically shown on the drawings, these fixtures shall be wired from junction boxes and 6'-0" unsupported whips. Provide number of junction boxes as required to allow for the 6'-0" whips. Wiring from fixture to fixture is not allowed. See Division 26 Section “Luminaires”.
   2. Lighting and Devices shown with same panel and circuit designation with no home run symbol may share same home runs to panelboards provided that the furthest device on the circuit does not exceed 2-1/2% voltage drop.
   3. Where home run symbols are shown, use separate run to panelboard for each symbol, and do not share home run with other devices having same panel and circuit designation.

1.10 PROJECT/SITE CONDITIONS

A. Coordinate with all other trades to ensure proper access and space requirements.

B. Where project conditions occur necessitating departures from the drawings, submit for approval the details of and reasons for departures prior to implementing any change.

C. Alterations
   1. Visit the site and become familiar with the existing conditions, and the requirements of the Plans and Specifications. No claim will be recognized for extra compensation due to failure of becoming familiar with the conditions and extent of the proposed work.
   2. Execute all alterations, additions, removals, relocations, or new work, etc., as indicated or required to provide a complete installation in accordance with the intent of the Drawings and Specifications.
   3. Repair or replace to the Owner's satisfaction, all existing work disturbed or damaged by the alterations.
   4. Except as follows, Retain ownership and remove from site all existing materials, equipment, fixtures, wiring and devices disconnected and not reused; Pay all charges for proper disposal of materials:
      a. Materials specifically indicated to be returned to Owner.
      b. Deliver to Owner: lighting fixtures
      c. Obtain receipt of delivery from Owner's Representative.

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5. Do not reuse existing wiring except as specifically indicated. Existing co
may be reused, provided that the existing wires are removed and new wire
6. Provide finished blank plates on all existing ceiling and wall boxes which
removed.
7. Ensure all circuits in existing buildings are re-energized where existing pa
replaced, or existing wiring is rerouted, disconnected, or disturbed. Provi
new wiring as required to meet this condition. Verify breaker/fuse sizes o
circuits and do not load wiring to beyond 75% of their ampacities.

1.11 SEQUENCING AND SCHEDULING

A. Construct Work in sequence under provisions of Division 01 Section “Summary”.

B. Schedule and coordinate all work with Division 02, “Selective Structure Demolition and Alterations”. Schedule and coordinate all work with Division 31, 32, 33. Demolition and removal of electrical items are included as part of Division 26. Patching of existing structure left by removals is specified under Division 02.

C. Arrange to execute the work at such times and in such locations as may be required to provide uninterrupted services for the occupied sections of the building or any of its sections. If necessary, install temporary work to provide for this condition. Authorization for interrupting services shall be obtained, in writing, from the Owner. Costs for overtime work and temporary work shall be included in the bid.

1.12 TEMPORARY LIGHT AND POWER

A. "Temporary Light and Power" specified under Division 01 Section “Temporary Facilities and Controls”.

B. Furnish all temporary equipment, wiring, lamps, etc., as required for the completion of the work, including the work of all Subcontractors.

C. Temporary electrical work shall comply with OSHA and NEC requirements.

D. Lighting level in all areas for the duration of construction period shall be a minimum of 5 foot candles or per OSHA requirements, whichever is greater. Provide a minimum of 50 foot candles for taping and painting of all surfaces, and for surfaces receiving finishes, including flooring and tile. When permanent light fixtures are installed, these units may be used to provide required lighting level, but shall be relamped with correct lamps prior to building turnover to Owner."

PART 2 - PRODUCTS

2.1 PAINTING

A. Refer to Division 09 Section ”Painting”.

2.2 ACCESS PANELS

A. Access panels required for items furnished under Division 26 shall be provided under this Division and installed under Divisions 08 and 09.

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B. Standard panels: 12" x 16" except as indicated. Doors: flush type 14-gauge ste
gauge frame. Latch: Flush face screw. All factory primed and painted to match
1. Same U.L. fire rating as wall, floor, or ceiling in which they are installed.
2. Equal To: Inryco/Milcor style "M" and Miami-Carey "HM".

PART 3 - EXECUTION

3.1 WORKMANSHIP AND INSTALLATION

A. Execute all work in a neat manner acceptable to the Local and State Electrical Inspector. Follow manufacturer's installation recommendations.

B. All electrical components and their attachments shall be properly supported and where required shall be designed for seismic forces.

C. Lighting fixtures shall be supported from structural members. Provide unistrut channels or equal to span between beams. Paint to match. See Division 26 “Luminaires”.

D. Perform all electrical work by licensed electricians well skilled in the trade and supervised by a Master Electrician.

E. Replace or repair to new condition, defective equipment and equipment damaged during installation or testing.

3.2 TESTING AND ADJUSTING

A. The entire installation shall be free from short circuits and improper grounds. Test in the presence of the Architects or their representatives.

B. Test feeders with the feeders disconnected from the branch circuit panels.

C. Test each individual branch circuit at the panel. In testing for insulation resistance to ground, the power equipment shall be connected for proper operation. In no case shall the insulation resistance be less than that required by the National Electrical Code and the manufacturer's recommendations. Correct failure in a manner satisfactory to the Architect and Engineers.

D. Completely test and adjust each system specified under Division 26 for proper operation.

3.3 SLEEVES, INSERTS AND OPENINGS

A. Sleeves:
1. Furnish and install all sleeves required for the work.
2. Sleeves through exterior building walls or through concrete construction shall be rigid galvanized steel.
3. Sleeves shall be sized to provide a total of not less than 1/2-inch clearance around conduit.
4. Sleeves for setting into walls shall be flush with finished construction. Sleeves for setting into floor shall be embedded in concrete slab and extend approximately 2 inches above finished floors.
5. All sleeved openings within building shall be sealed airtight using fire barrier caulking with a UL classification for use as a fire penetration seal for walls and floors with up to a 3-hour fire rating expanded.

6. Sleeves shall be provided in all locations where cables and conduits penet floors.
7. Selection of firestopping materials and installation shall be in accordance specifications Division 07 Section “Through Penetration Firestop System Firestopping”.

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SECTION 260111 – CONDUIT

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Metal Conduit.

B. Flexible Metal Conduit.

C. Liquidtight Flexible Metal Conduit.

D. Electrical Metallic Tubing (EMT).

E. Non-Metallic Conduit.

F. Fittings and Conduit Bodies.

1.2 RELATED SECTIONS

A. Division 01 Section “Submittal Procedures”.

B. Division 07 Section “Thermoplastic Membrane Roofing.” For penetrations.

C. Division 07 Section “Through Penetration Firestop Systems.”

D. Division 26 Section “Basic Electrical Requirements”.

1.3 REFERENCES

A. NECA "Standard of Installation."

B. NEMA Standards.

C. NFPA 70 N.E.C. latest edition.

D. U.L. Standards.

1.4 DESIGN REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70 (N.E.C.)

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

C. Conduit Size: ANSI/NFPA 70 (N.E.C.) for conductors indicated. Increase size as required to include bonding conductors specified.

1.5 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section “Submittal Procedures”.

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B. Include only nonmetallic conduit (PVC) with associated fittings and describe int

C. Include expansion fittings for all conduit types used on the project.

D. Include fire-stop seals and fillers.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section "Project Management and Coordination".

B. Accurately record actual routing of conduits larger than 1 inch.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Division 01.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

1.8 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to meet project conditions.

D. Where conduit routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS

A. Except as otherwise specifically noted, all wiring throughout the building, including each of the systems specified, shall be enclosed in minimum size 1/2 inch conduit.

B. Underground Installations:
   1. Use rigid galvanized steel conduit, intermediate metal conduit, plastic coated steel conduit, thickwall nonmetallic conduit PVC-80, thinwall nonmetallic conduit PVC-40.
   2. In or Under Slab on Grade:
      a. Use rigid galvanized steel conduit, intermediate metal conduit, plastic coated steel conduit, thickwall nonmetallic conduit PVC-80 and thinwall nonmetallic conduit PVC-40.
      b. Rise through slab in rigid galvanized steel conduit.
      c. Conduit larger than 3/4" shall run below slab.

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3. Minimum Size: 3/4 inch.
4. Under paved areas: rigid galvanized steel conduit or concrete encased PV
5. Metallic conduits buried in soil: Coated with Bitumastic #50.
6. Communications (telephone, data, catv) service entrance conduits from ri PVC-40, concrete encased where indicated.

C. Outdoor Locations, Above Grade: Use rigid galvanized steel and aluminum con intermediate metal conduit.

D. In Slab Above Grade:
1. Use rigid galvanized steel conduit, intermediate metal conduit, electrical metallic tubing with water tight connectors.
2. Maximum Size Conduit in Slab: 3/4 inch.
3. Rise through slab in rigid galvanized steel conduit.

E. Interior Wet and Damp Locations: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit.

F. Dry Locations:
1. Concealed: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit, electrical metallic tubing.
2. Concealed/ Accessible: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit, electrical metallic tubing.
3. Exposed: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit, electrical metallic tubing.
   a. Finished areas: Exposed galvanized conduit run high between framing members.

G. Panel Feeders: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit, electrical metallic tubing in accordance with locations herein specified.

H. Couplings and connectors for electrical metallic tubing up to 2" shall be steel set screw or compression type. Set-screw connection shall be used for all tubing sizes with a minimum of four set-screws for coupling and two set-screws for connectors and fittings for sizes 1-1/4" and larger.

I. Couplings and connectors for rigid and intermediate metal conduit shall be threaded.

J. Termination for all conduit and tubing shall have insulated bushings or insulated throat connectors in accordance with code requirements.

K. Permanent Connection to Motors: Dry locations, use flexible metal conduit. Damp or wet locations, use flexible liquidtight Type UA conduit with approved liquidtight fittings. Maximum length two feet (2').

PART 3 - EXECUTION

3.1 INSTALLATION

A. In general, all raceways shall be concealed within finished walls - securely supported in accordance with code requirements. Wiring in areas with no finished ceilings (exposed construction) shall be exposed overhead such that all raceways are parallel or perpendicular to

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joists, columns or beams and all drops to wall devices shall be concealed in wall

B. Aluminum conduits shall not be installed below grade or in poured concrete or n

C. Install conduit in accordance with NECA "Standard of Installation."

D. Install nonmetallic conduit in accordance with manufacturer's instructions.

E. Arrange supports to prevent misalignment during wiring installation.

F. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

G. Group Related Conduits:
   1. Support using conduit rack of Power-Strut, or approved equal.
   2. Parallel runs shall be neatly clustered with all bends and offsets of uniform pattern
   3. Provide space on each for 25 percent additional conduit.

H. Substantially support with approved clips or hangers spaced not to exceed ten feet (10') on centers except 1/2" rigid conduit and 1/2" and 3/4" electrical metallic tubing shall have supports spaced not to exceed six feet (6').

I. Fasten conduit supports to building structure.
   1. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
   2. Do not attach conduit to ceiling support wires.
   3. Conduits larger than 2” shall be supported from suitable structure.

J. Arrange conduit to maintain headroom and present neat appearance.

K. Route conduit parallel and perpendicular to walls.

L. Route conduit in and under slab from point-to-point.
   1. Install only where specifically indicated or required.
   2. Obtain approval from the Architect before installation.

M. Do not cross conduits in slab.

N. Maintain adequate clearance between conduit and piping.

O. Maintain 6 inch clearance between conduit and surfaces with temperatures exceeding 104ºF.

P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

Q. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

R. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction. Use factory elbows or hydraulic one-shot bender to fabricate bends in metal conduit 2 inches or larger in size.

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S. Avoid moisture traps; provide junction box with drain fitting at low points in co

T. Provide suitable fittings to accommodate expansion and deflection where condu seismic, control and expansion joints.

U. Provide suitable labeled nylon pull string in each empty conduit.

V. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

W. Use sleeves when passing through floors and walls.

X. When serving roof top equipment, conduit shall enter within the weather-proof curbing. Maintain water tight roofing system.

Y. Ground and bond conduit under provisions of Division 26 Section “Grounding and Bonding.”

Z. Identify conduit under provisions of Division 26 Section “Electrical Identification.”

AA. All elbows in nonmetallic conduit runs shall be rigid galvanized steel to eliminate "burn through" when pulling in conductors.

3.2 FIELD QUALITY CONTROL

A. No wire shall be installed until work which might cause damage to wires or conduits has been completed.

B. Conduits shall be thoroughly cleaned of water or other foreign matter before wire is installed.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire-resistance rating of partitions and other elements, using approved seals, fillers and materials.

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SECTION 260123 - WIRE AND CABLE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Building wire and cable.

B. Underground feeder and branch circuit cable.

C. Service entrance cable

D. Metal clad cable.

E. Wiring connectors and connections.

1.2 RELATED SECTIONS

A. Division 26 Section 260010 “Basic Electrical Requirements.”

B. Division 26 Section 260111 “Conduit.”

C. Division 26 Section 260112 “Surface Raceways.”

D. Division 26 Section 260130 “Boxes.”

E. Division 26 Section 260195 “Electrical Identification.”

1.3 REFERENCES

A. NEMA Standards.

B. NFPA 70 N.E.C. Latest Edition.

C. U.L. Standards.

1.4 DESIGN REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70. (N.E.C.)

B. Furnish products listed and classified by Underwriters' Laboratories, Inc. as suitable for purpose specified and shown.

C. Unless Indicated Otherwise, Conductor Sizes Shown Are Based on Copper:
   1. If aluminum option for conductors No. 4 AWG and larger is chosen, increase the conductor size to have the same ampacity and same or less impedance as the copper size indicated; increase the conduit and pull box sizes to accommodate the larger size aluminum conductors in accordance with NFPA 70; assure that the pulling tension rating of the aluminum conductor is sufficient; relocate equipment, modify equipment terminations, re-size equipment, and resolve to the satisfaction of the Architect all problems that are the results of the use of aluminum conductors in lieu of copper.

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2. Equipment Manufacturer Requirements: Where equipment is provided w manufacturer requires copper conductors at the terminations, or requires t conductors be provided between components of equipment, provide copp all necessary splices, splice boxes, and other work required to satisfy man requirements.

D. Manufacturer's name, wire size and insulation type shall be clearly marked on th jacket.

1.5 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section "Submittal Procedures."

B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency.

C. Include MC manufacturer's specification sheets indicating construction, diameter, ampacity and bending radius.

D. Include aluminum wire; type, sizes, locations used.

1.6 PROJECT CONDITIONS

A. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.

B. Where wire and cable routing is not shown, and destination or circuit number only is indicated, determine exact routing and lengths required.

1.7 COORDINATION

A. Locate such that outlets are readily accessible.

B. Determine required separation between cable and other work.

C. Determine cable routing to avoid interference with other work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. American Insulated Wire Corp.

B. Alcan Cable

C. Carol Cable.

D. General Cable.

E. The Okonite Co.

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F. Paranite Essex Group.

G. Triangle PWC, Inc.

H. Prysmian Cables and Systems.

I. Superior Essex Inc.

J. Southwire Company.

2.2 WIRE AND CABLE

A. Description: Single conductor insulated wire.

B. Conductors: Sizes #6 AWG and Smaller: Copper. Sizes #4 AWG and larger: Copper or aluminum unless the type of conductor material is specifically indicated, specified, or required by equipment manufacturer.

C. Aluminum Conductors: Aluminum alloy that is listed by Underwriters' Laboratories, Inc. Standard 486B, marked "AL9CU" for 90EC. rated circuits and shall be equal to Annealed Stabiloy compact stranded (Aluminum Association 8000 series aluminum alloy) as manufactured by Alcan Cable - Atlanta, GA.

D. Insulation Voltage Rating: 600 volts.

E. Insulation: ANSI/NFPA 70 (N.E.C.), Type THHN/THWN, XHHW, rated 90 degrees C.

2.3 METAL CLAD CABLE

A. Description: ANSI/NFPA 70 (N.E.C.), Type MC with separate insulated ground.

B. Conductor: Copper, [maximum # 10 AWG].

C. Insulation Voltage Rating: 600 volts.

D. Insulation Temperature Rating: 90ºC.

E. Armor Material: Aluminum.

F. Armor Design: Interlocked Metal Armor or Corrugated tube

G. Jacket: None

2.4 WIRING CONNECTORS

A. Use the Following Types As Herein Specified:
1. Split bolt connectors.
2. Solderless pressure connectors.
3. Spring wire connectors.
4. Compression connectors.
5. Insulation piercing connectors.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that mechanical work likely to damage wire and cable has been complete

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRING METHODS

A. Concealed Dry Interior Locations: Use only wire Type THHN/THWN insulation, in raceway or metal clad cable.

B. Accessible Dry Interior Locations (such as above acoustical ceilings): Use only wire Type THHN/THWN insulation, in raceway or metal clad cable.

C. Exposed Dry Interior Locations:
1. Use exposed wiring only where specifically indicated.
2. Use only building wire Type THHN/THWN insulation, in raceway. Type MC cable may be exposed in mechanical rooms and where specifically indicated.

D. Wet or Damp Interior Locations: Use only building wire Type THWN, XHHW, XHHW-2 insulation, in raceway.

E. Exterior Locations: Use only building wire Type THWN, XHHW, XHHW-2 insulation, in raceway.

F. Underground Installations: Use only building wire Type XHHW or XHHW-2 insulation installed in raceway..

G. Panel Feeders: Use only building wire Type XHHW and XHHW-2 insulation, in raceway.

H. Use other wiring methods only as specifically indicated on Drawings.

3.4 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Except as otherwise specifically noted, all wiring throughout the building, including each of the systems specified, shall be enclosed in raceways.

C. In general, all wire in raceways shall be concealed above ceilings and within finished walls, securely supported in accordance with code requirements. Wiring in areas with no finished ceilings (exposed construction) shall be raceways exposed overhead, but run along structures such that raceways have minimum visibility and such that all raceways are parallel or perpendicular to joists, columns or beams and concealed in walls.

D. Use solid conductor for feeders and branch circuits #10 AWG and smaller. At contractors option

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stranded conductors for #10 AWG and smaller shall be permitted as long as vin
support crimp-on fork terminals are use for all screw head terminations. Barrel l
activated compression clamps on back wired devices shall not require crimp-on t

E. Use stranded conductor for feeders and branch circuits #8 AWG and larger.

F. Use stranded conductors for control circuits.

G. Minimum Size Conductors for Power and Lighting Circuits #12 AWG Except as Follows:
   1. Minimum #10 AWG for 120 volt circuits more than 100 feet long.
   2. Sizes shall be not less than indicated.
   3. Note: Wire sizes indicated on drawings and schedules are minimum requirements and shall be adjusted to meet the above criteria.

H. Use conductor not smaller than #16 AWG for control circuits with fusing sized accordingly.

I. Pull all conductors into raceway at same time.

J. Use suitable wire pulling lubricant for building wire #4 AWG and larger.

K. Support cables above accessible ceiling, using spring metal clips or approved cable ties to support cables from structure. Do not support from ceiling suspension system. Do not rest cable on ceiling panels. Do not drape over ductwork or between bar joists. Wiring shall not be run diagonally and shall be cabled neatly.

L. Use approved cable fittings and connectors.

M. Neatly train and lace wiring inside boxes, equipment, and panelboards.

N. Clean conductor surfaces before installing lugs and connectors.

O. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

P. Use split bolt connectors, insulation piercing connectors or U.L. approved insulated connectors for copper conductor splices and taps, #6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

Q. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, #8 AWG and smaller.

R. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

S. Wiring in sleeves passing through fire-rated barriers shall be sealed/filled with approved material to maintain the fire rating.

T. Terminations Involving Aluminum Conductors:
   1. Make with solderless circumferential compression type, aluminum bodied connectors UL listed for AL/CU. Remove all surface oxides from aluminum conductors by wire brushing and immediately apply an oxide inhibiting joint compound and insert in connector. After joint is made, wipe away excess joint compound and insulate splice.

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2. Terminate aluminum conductors to copper bus by utilizing a circumferent type, aluminum bodied terminal lug UL listed for AL/CU, and steel Belle washers, flat washers, bolts, and nuts. Belleville spring washers shall be c cadmium-plated hardened steel. Take care to install the Belleville spring crown up toward the nut or bolt head, with the concave side of the Bellev heavy-duty, wide series flat washer of larger diameter than the Belleville. sufficiently to flatten Belleville and leave in that position. Lubricate all h joint compound prior to making connection. Wire brush and apply joint compound to conductor prior to inserting in lug.
3. Terminate aluminum conductors to aluminum bus by utilizing all aluminum nuts, bolts, washers, and compression lugs. Wire brush and apply joint compound to conductor prior to inserting in lug. Lubricate all hardware with joint compound prior to making connection; if bus contact surface is unplated, scratch-brush and coat with joint compound (without grit).

3.5 INTERFACE WITH OTHER PRODUCTS

A. Identify wire and cable under provisions of Division 26 Section 260195 “Electrical Identification”.

B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.6 FIELD QUALITY CONTROL

A. Inspect wire and cable for physical damage and proper connection.

B. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

C. Verify continuity of each branch circuit conductor.

D. Verify proper operation of each circuit.

3.7 TESTING

A. For conductors larger than #8AWG, perform Insulation-Resistance Test on each field-installed conductor with respect to ground and adjacent conductors.
1. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable.
2. Take readings after 1 minute and until the reading is constant for 15 seconds.
3. Minimum insulation-resistance values shall not be less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable.

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SECTION 260130 - BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wall and Ceiling Outlet Boxes.

B. Pull and Junction Boxes.

C. Hinged Cover Cabinet Enclosures.

D. Terminal Blocks and Accessories.

E. RELATED SECTIONS

F. Division 07 Section “Through Penetration Firestop Systems”

G. Division 08 Section “Access Doors and Frames”

H. Division 26 Section 260010 “Basic Electrical Requirements.”

I. Division 26 Section 260111 “Conduit.”

J. Division 26 Section 260141 “Wiring Devices.”

K. Division 26 Section 260170 “Grounding and Bonding.”

L. Division 26 Section 260180 “Equipment Wiring.”

1.2 REFERENCES

A. NEMA Standards.

B. NFPA 70 N.E.C. Latest Edition.

C. U.L. Standards.

1.3 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section “Submittal Procedures”.

B. Include product data for boxes larger than 12x12x6 inches

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Project Record Documents”

B. Accurately record actual locations and mounting heights of outlets if not as shown on Drawings, plus pull and junction boxes larger than 12x12x6 inches and boxes used for panel feeders.

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1.5 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70. (N.E.C.)

B. Furnish products listed and classified by Underwriters' Laboratories, Inc. as suit specified and shown.

C. Size per N.E.C. Art. 314.

1.6 PROJECT CONDITIONS

A. Verify field measurements are as shown on Drawings.

B. Verify locations of wall boxes and outlets in offices,,and work areas prior to rough-in.

C. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose.

D. Generally pull boxes are not shown on Drawings. Provide as required.

1.7 COORDINATION

A. Locate such that outlets are readily accessible and does not interference with other work.

B. Provide for access panel where required.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

A. Sheet Metal Outlet Boxes: Standard type galvanized steel, minimum four inch square or octagon by 2-1/8 inch deep.
   1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
   2. Concrete Ceiling Boxes: Concrete type, three and four inch deep or depth as to coordinate with concrete slab.
   3. Single Wall Type: Minimum size, four inch square by 1-1/2 inch deep, except as noted. Provide dry wall plaster rings raised as required to insure flush finish mounting.
   4. Ganged Wall Type: Minimum depth 3 inches except as noted, ganged as required under common plate to contain device shown.

B. Cast Boxes: Type FS shallow type FD deep , aluminum or , cast feralloy.
   1. Provide number of threaded hubs as required.
   2. Use in all exterior, damp or exposed in mechanical space.
   3. Provide gasketed cover and accessories by box manufacturer for complete weatherproofing.

2.2 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: Standard type galvanized steel, minimum four inch square or octagon by 2-1/8 inch deep.

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1. Sizes up to 12x12x6 inch: Provide screw-type or hinged covers.
2. Sizes greater than 12x12x6 inch: Provide hinged covers.

B. Exterior Surface-Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, su junction box.
1. Material: Galvanized cast iron or Cast aluminum.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

2.3 CABINET ENCLOSURES

A. Covers: Continuous hinge, held closed by flush latch operable by screwdriver.; finish in gray baked enamel..

B. Boxes: Galvanized steel minimum 12"x12"x6" deep or as noted. Provide 3/4 inch (19 mm) thick plywood backboard painted matte white, for mounting terminal blocks.

C. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.

D. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 300 volts.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
1. Except where specifically noted, boxes on finished surfaces shall be flush mounted with finished cover plate.
2. Consult Architect prior to installing in finished areas.

B. Install electrical boxes to maintain headroom and to present neat mechanical appearance.

C. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

D. In Non-accessible Ceiling Areas: Install outlet and junction boxes no more than 12 inches from ceiling access panels or from removable recessed luminaires such that they are accessible.

E. In accessible Ceiling Areas: Install outlet and junction boxes such that they are accessible from ceiling access panels or from removable recessed luminaires.

F. Install boxes to preserve fire-resistance rating of partitions and other elements, using materials and methods under the provisions of Division 07 Section “Through Penetration Firestop Systems”

G. Align Wall Boxes for Switches, Receptacles, Thermostats, Telephone, and Similar Devices with Each Other as Follows:
1. Horizontally for outlets with same mounting height.
2. Vertically for outlets shown in similar locations with different mounting heights.

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H. Do not install flush mounted boxes back-to-back in walls; provide minimum 6 ir
Provide minimum 24 inches separation in acoustic and fire rated walls.

I. Accurately position flush mounted wall boxes to allow for surface finish thickne
1. Box shall be flush with finished surface.
2. Use wall box support brackets that span two studs.
3. Single stud support will be allowed only if used with Caddy H series E-Z Mount Brackets or equal product to support side opposite the stud.

J. Install flush mounting box without damaging wall insulation and vapor barrier or reducing its effectiveness.

K. Use adjustable steel channel fasteners for hung ceiling outlet box.

L. Do not fasten boxes to ceiling support wires.

M. Support boxes independently of conduit.

N. Use gang box where more than one device is mounted together. Do not use sectional box.

O. Use 4" square box with plaster ring for single device outlets.

P. Use cast outlet box in exterior locations and wet locations.

Q. Large Pull Boxes: Boxes larger than 100 cubic inches in volume or 12 inches in any dimension.
1. Interior Dry Locations: Use hinged covers.
2. Other Locations: Use surface-mounted cast metal box.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations and sizes of required access doors with Division 08 Section “Access Doors and Frames”.

B. Locate flush mounting box in masonry wall to require cutting of only one masonry unit. Coordinate masonry cutting to achieve neat opening.

C. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.

D. Position outlet boxes to locate luminaires as shown on reflected ceiling plan.

3.3 ADJUSTING

A. Adjust floor box flush with finish flooring material.

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SECTION 260141 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wall Switches.

B. Wall Dimmers.

C. Receptacles.

D. Device Plates.

1.2 RELATED SECTIONS

A. Division 07 Section “Through-Penetration Firestop Systems.”

B. Division 26 Section 260010 “Basic Electrical Requirements.”

C. Division 26 Section 260130 “Boxes.”

1.3 REFERENCES

A. NEMA Standards.

B. NFPA 70 N.E.C. Latest Edition.

C. U.L. Standards.

1.4 SUBMITTALS

A. Submit Shop Drawings for equipment and component devices in accordance with Division 01 Section “Submittal Procedures”.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

C. Include documentation showing compliance with UL, Fed. Spec. and NEMA references.

1.5 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters' Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

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A. Manufacturers' Names: Shortened versions (shown in parentheses) of the follow manufacturers' names are used in other Part 2 articles:
   1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
   2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
   3. Leviton Mfg. Company Inc. (Leviton).
   4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymo

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
   1. Cooper; 5351 (single), 5352 (duplex).
   2. Hubbell; HBL5361 (single), CR5352 (duplex).
   3. Leviton; 5891 (single), 5352 (duplex).
   4. Pass & Seymour; 5381 (single), 5352 (duplex)

B. Device Body:
   1. Wall mounted devices shall be Brown.
   2. Ceiling mounted devices shall be Brown.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed -through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped. Will not energize if line and load wiring are reversed.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
   1. Cooper; GF20.
   2. Hubbell; GFR5352
   3. Pass & Seymour; 2095

2.4 RECEPTACLES

A. Receptacles shall represent manufacturer's highest quality receptacles other than hospital grade. Receptacles shall be back and side wired, provide green ground screw terminal, automatic ground clamp, fully enclosed in composition case, nylon face, and have all brass wrap around bridge for installation strength. Receptacles shall be UL 498 listed, Fed. Spec. WC596 and NEMA WD-6compliant. Duplex Convenience Receptacle, NEMA 5-20R, Rated 20 Amp:
   1. Hubbell, Model HBL5362 or HBL5352.
   2. P&S, Model 5362A
   3. Leviton, Model 5362A.

B. GFCI Duplex Receptacle, Rated 20 Amp:
   1. Same construction as specified above except with integral GFCI.

C. Device Body: Nylon type, color: Brown, except as noted.

D. GFCI Receptacle: U.L. Class A integral ground fault circuit interrupter.

2.5 WALL SWITCHES

A. Comply with NEMA WD 1 and UL 20.

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B. Switches, 120/277 V, 20 A:
   1. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (fou
   2. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), way).
   3. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 122
   4. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three (four way)

C. Provide key switches, three-way, four-way switches, etc., as indicated matching the Series listed above. For keyed switches, provide minimum 2 keys per keyed device.

D. Device Body: Toggle handle type, color: Brown.

E. Pilot Light: Neon type #1720-120v red. Separate gang position combined under same plate as switch or separately mounted.

2.6 STANDARD WALL DIMMERS

A. Manufacturers:
   1. Lutron. Model NOVA-T Series except as indicated.
   2. Lightolier
   3. Or equal

B. Plastic with linear slide.

C. Voltage: 120 volts.

D. Power Rating: No less than 125% of load shown on Drawings. Minimum rating: 1000 watts.

E. Device Body & Plate: Brown.

F. Note that dimmers shall be compatible with loads indicated. Where dimmers are shown serving electronic solid state low voltage transformers such as for MR16 Lamps, then provide appropriate amplifier modules for proper operation. Locate as indicated or above accessible ceiling. Wire as required by the manufacturer's installation instructions.

2.7 WALL PLATES

A. Decorative Cover Plate: Brown, smooth face nylon.

B. Weatherproof Cover Plate: Gasketed heavy-duty die-cast zinc with self-closing hinged lid, Leviton 4926 Series.

C. Utility Area Cover Plates for Surface Mounting: Cadmium plated steel with rounded edges.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install devices and plates vertical and plumb. Boxes shall be flush with finished surface.

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C. Provide matching blank face plate for all unused wall boxes.

D. Install switches with Off position down.
   1. Locate close to door frame on latch side of door, or beyond swing of door appropriate.
   2. Where door frames have side lights, switch shall be either located below s 3'-0" mounting height is possible, or beyond the side light. Coordinate wi schedule.
   3. Switches indicated in the same area at the same mounting heights shall be ganged together under a common plate.

E. Install wall dimmers to achieve full rating specified. Do not break off cooling fins. Mount in separate gangs as required.

F. Do not share neutral conductor on load side of dimmers.

G. Install receptacles with grounding pole on top.

H. Where devices such as duplex receptacles, telephone/data outlets, and TV outlets are shown adjacent to each other, then group all under a common face plate.

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SECTION 260170 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Grounding electrodes and conductors.

B. Equipment grounding conductors.

C. Bonding.

1.2 RELATED SECTIONS

A. Division 26 Section 260010 “Basic Electrical Requirements.”

1.3 REFERENCES

A. NEMA Standards.

B. NFPA 70 (N.E.C.) Latest Edition.

1.4 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: Conform to requirements of ANSI/NFPA 70. (N.E.C.), except that the Minimum System Resistance shall be 10 ohms.

1.5 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section ”Submittal Procedures”.

B. Product Data: Provide data for grounding electrodes and connections.

C. Manufacturer's Instructions: Include instructions for protection, examination, preparation and installation of exothermic connectors.

1.6 GROUNDING ELECTRODE SYSTEM

A. Metal underground water pipe.

B. Rod electrode.

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Project Management and Coordination”.

B. Accurately record actual locations of grounding electrodes.

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2.1 ROD ELECTRODE

A. Manufacturers:
   1. ITT Blackburn
   2. Substitutions: Under provisions of Division 01 Section “Substitutions and Product Options”.

B. Material: Copper, Copper-clad carbon steel.

C. Diameter: 3/4 inch.

D. Length: Sectional 10 feet.

E. Use only "Acorn" style ground clamps for connections to rods.

2.2 MECHANICAL CONNECTORS

A. Material: Bronze.

2.3 EXOTHERMIC CONNECTIONS

A. Manufacturers:
   1. Cadweld.
   2. Thermoweld .
   3. Substitutions: Under provisions of Division 01 Section “Substitutions and Product Options”.

2.4 WIRE

A. Material: Copper.

B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements, but not smaller than indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Install rod electrodes at locations indicated and as required. Install additional rod electrodes as required to achieve specified resistance to ground.

C. Install ground wire from water entrance to main service entrance.

D. Equipment Grounding Conductor: Provide separate, 600 volt insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

E. Provide and install bonding conductor to each item of electrical equipment.

F. Bonding conductors shall be continuous where possible. Where splices are requ
& B, or approved equal, compression connectors of approved pattern. Insulate c
equivalent thickness of conductors.

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SECTION 260180 - EQUIPMENT WIRING

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Electrical Connections to Equipment Specified under Other Sections Or Furnished by Owner, Including but Not Limited to: Exhaust fans, air handling units, air-conditioning units, circulators, heating system pumps, burner.

B. All line voltage wiring including final branch circuit connections to disconnects, motor controllers, Variable Frequency Drives (VFD), Isolation transformers, and motors. See Drawings for wiring and equipment locations.

C. Fused and non-fused disconnect switches for the equipment, except disconnect switches specifically provided with the equipment.

D. Except as specifically noted, motors, variable frequency drives (VFD), isolation transformers for VFD, magnetic or manual starters and thermal overload protection will be furnished with the equipment for installation under Division 26 Section 260180.
   1. Single pole switches, switch and pilots, and light/fan switches shall be provided and installed under Division 26 Section 260180. Coordinate with equipment schedules on H&V Drawings.

E. Temperature Control Wiring: Provided and installed under Division 23 Section “Instrumentation and Controls for HVAC Systems”.

F. Roof Top Equipment: Whether shown or not on the Drawings, provide a weather proof GFCI service receptacle at units per code requirements. For 120 volt, 15 and 20 amp equipment, connect to line side of safety switch. For larger equipment, provide home run to nearest 120 volt, 20A, 1 pole spare breaker. Label and show on as-built drawings.

1.2 RELATED SECTIONS

A. Division 01 Section "Summary".

B. Division 08 Section “Openings”.

C. Division 11 Section “Equipment”

D. Division 22 Section “Plumbing”.

E. Division 23 Section “Heating Ventilation and Air Conditoning”.

F. Division 26 Section "Basic Electrical Requirements".

1.3 REFERENCES

A. NEMA Standards.

B. NFPA 70 (N.E.C.) Latest Edition.

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C. U.L. Standards.

D. ANSI Standards.

1.4 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70. (N.E.C.)

B. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

C. Drawings do not show all required disconnect servicing switches. Furnish and locate as required by N.E.C.

D. Size fuses and thermal elements per N.E.C. and manufacturer's recommendations.

E. Connect motors for correct voltage, phase and rotation.

1.5 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section "Submittal Procedures".

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Westinghouse.

B. I-T-E Siemens.

C. General Electric.

D. Square D.

2.2 DISCONNECT SWITCHES

A. Enclosed, heavy-duty type, except as noted with visible blades, Horsepower rated 600-volt and 250-volt ratings as required by the particular circuit.

B. NEMA-1 enclosure, for dry locations; NEMA-3R raintight for exterior locations.

C. Fuses and ampere rating and number of poles as indicated on Drawings, or as required by the specific equipment.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

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3.2 PREPARATION

A. Review equipment submittals prior to installation and electrical rough-in. Verify and type of connections. Coordinate details of equipment connections with supp installer.

3.3 INSTALLATION

A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment, but in no case less than the wire specified under Division 26 Section 260123 “Wire and Cable.”

B. Conduit Connections to Equipment: Dry locations, use flexible conduit. Damp or wet locations, use flexible liquidtight Type UA conduit with approved liquidtight fittings. Maximum length two feet (2').

C. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.

D. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.

E. Semiportable Machines: Use heavy-duty oil-resistant type SO cord with stranded copper conductors No. 12 AWG, minimum size and number of wires as required to include each phase conductor, white neutral conductor, and green grounding conductor. Furnish and install Kellems Series H cord grips and spring hangers for each cord connected machine with overhead supply.

F. Make wiring connections in wiring compartment of prewired equipment in accordance with manufacturer's instructions.

G. Install disconnect switches, controllers, control stations, temperature switches as indicated or required.

H. Coolers and Freezers: Cut and properly seal conduit openings in freezer and cooler walls, floor, and ceilings to prevent condensate buildup. Use silicone caulking on outside of conduit penetration and listed foam in place sealant inside of conduit penetration..

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SECTION 260195 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Nameplates and Tape Labels.

B. Wire and Cable Markers.

C. Conductor Color Coding.

1.2 RELATED SECTIONS

A. Division 26 Section 260010 “Basic Electrical Requirements.”

1.3 REFERENCES

A. NFPA 70 (N.E.C.) Latest Edition.

1.4 REQUIREMENTS

A. Label all panelboards, all safety switches, controls, relays, junction boxes, pull boxes, pilot lights, special switches and outlets. Label on panelboards shall include name and circuit number of source.

B. Nameplates shall identify function of device, space controlled, voltage conditions, fuse size, panel serving switch, as indicated or required without abbreviations. Details shall be as approved.

C. Conform to requirements of ANSI/NFPA 70. (N.E.C.) Art. 200 for grounded neutral conductor, Art. 210 for branch circuits and art. 250 for grounding (bonding) conductor.

1.5 SUBMITTALS

A. Submit Shop Drawings, in accordance with Division 01 Section “Submittal Procedures”.

B. Only include if details of nameplates, wiring markers and conductor color code are not as specified below.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Nameplates: Engraved three-layer laminated plastic, white letters on a black background.

B. Tape Labels: Embossed adhesive tape, with 3/16 inch white letters on black background.

C. Junction Box Labels: Hand lettered inside box cover with indelible black marker. Indicate voltage and circuit.

D. Wire and Cable Markers: Cloth markers, split sleeve or tubing type.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Install nameplates and tape labels parallel to equipment lines.

B. Secure nameplates to equipment fronts using screws, or rivets, or adhesive. Secure nameplate to inside face of recessed panelboard doors in finished locations. Secure nameplate to outside face of surface panelboards in unfinished locations.

C. Use embossed tape only for identification of individual wall switches and receptacles, control device stations.

3.2 WIRE IDENTIFICATION

A. Conductors throughout the building shall be color coded to identify voltage and phases.
   1. All metallic bonding conductors - Green.
   2. Phase Conductors of 120/208 Volt System: Black, red, blue. Neutral: white.
   3. Phase Conductors of 120/240 Volt System: Black, red. Neutral: White.

B. All circuit conductors of the same color shall be connected to the same ungrounded feeder conductor throughout the installation.

C. Where Conductors Are Not Available in the Colors Indicated, Due to Size, Prewired Cable, or Other Reason: Install identifying adhesive bands 3/4" wide of colors indicated above around each conductor within six inches (6") and twelve inches (12") of each end and at a maximum of five foot (5') intervals along wireways, at back of panelboards, and wherever conductors are accessible.

D. Power and Lighting Circuits in Panelboard Gutters, Pull Boxes, Outlet and Junction Boxes, and at Load Connection: Provide wire markers on each conductor and Identify with branch circuit or feeder number.

E. System Control Wires at Control Panel and Load Connection:
   1. Provide wire markers on each conductor and identify with number as indicated on equipment manufacturer's Shop Drawings.
   2. Fire Alarm System: Follow local Fire Department color code and labeling standards.

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SECTION 260420 - SERVICE ENTRANCE

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Arrangement with Power Company for permanent electric service.

B. Arrange with Power Company to provide for metering.

C. Secondary wires and conduits from Power Company Tap box in basement to service entrance equipment.

1.2 RELATED SECTIONS

A. Division 26 Section 260010 “Basic Electrical Requirements.”

B. Division 26 Section 260111 “Conduit.”

C. Division 26 Section 260123 “Wire and Cable.”

D. Division 26 Section 260130 “Boxes.”

E. Division 26 Section 260170 “Grounding and Bonding.”

1.3 SYSTEM DESCRIPTION

A. System Voltage: 120/208 volts, three phase, four wire, 60 Hertz.

1.4 REFERENCES

A. NEMA Standards.

B. NFPA 70 (N.E.C.) latest edition.

C. U.L. Standards.

D. ANSI Standards.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70. (N.E.C.).

B. Furnish products listed and classified by Underwriters Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

C. Power Company: Central Maine Power Co.
   1. Contact: Paul Duperre
   2. Tel (207)753-3118

D. Install in accordance with Power Company's rules and regulations.

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1.6 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accorda
Division 01 Section "Submittal Procedures".

B. Include modular metering equipment

PART 2 - PRODUCTS

2.1 METERING EQUIPMENT

A. Self-contained modular metering equipment:
1. Section 1:
   a. 400 Amp 3 phase 3 wire
   b. Equal to Schneider Electric EZML331400
2. Section 2:
   a. 125Amp 1 phase 3 wire
   b. 100Amp branch breaker
   c. Equal to Schneider Electric EZMR313125
3. Terminal box:
   a. 600A 3 phase 3 wire
   b. Equal to Schneider Electric EZM3600TB
4. Provide additional equipment as required. Size and details as approved by the Power Company.

B. Meter Socket: As listed and approved by the Power Company.

2.2 SECONDARY CONDUCTORS

A. Specified Under Division 26 Section 260123 "Wire and Cable."

2.3 CONDUITS

A. Specified Under Division 26 Section 260111 "Conduit."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Make arrangements with Power Company to obtain permanent electric service to the Project.

B. CMP to provide secondary conductors from understreet structure through existing conduits to existing tap box in basement. Contractor to provide secondary conductors and conduits from tap box to new secondary metering equipment (see drawings). Existing metering equipment to be removed.

C. Power Company will connect service lateral conductors to service entrance conductors.

END OF SECTION 260420

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SECTION 260440 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Disconnect Switches.

B. Fuses.

C. Enclosures.

1.2 RELATED SECTIONS

A. Division 26 Section 260010 “Basic Electrical Requirements.”

B. Division 26 Section 260170 “Grounding and Bonding.”

C. Division 26 Section 260180 “Equipment Wiring.”

D. Division 26 Section 260195 “Electrical Identification.”

E. Division 26 Section 260470 “Panelboards.”

1.3 REFERENCES

A. NEMA Standards.

B. NFPA 70 (N.E.C.) Latest Edition.

C. U.L. Standards.

D. ANSI Standards.

1.4 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70. (N.E.C.)

B. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

C. Size per N.E.C. and Equipment Manufacturers' Recommendations.

1.5 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section “Submittal Procedures.”

B. Include outline drawings with dimensions, and equipment ratings for voltage, capacity, horsepower, and short circuit.

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1.6 SPARE PARTS

A. Fuses: Furnish to Owner three (3) spare fuses for each circuit and each device Maximum of six (6) spare fuses of each type and rating installed.

B. Fuse Cabinet: Provided under Division 26 Section 260470 - Panelboards.

C. Fuse Pullers: Furnish one fuse puller to Owner.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

A. Acceptable Manufacturers:
1. Cutler Hammer.
2. I-T-E Siemens.
3. General Electric.
4. Square D.

B. Fusible Switch Assemblies: Heavy-duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Designed to accommodate Class R fuses.

C. Nonfusible Switch Assemblies: Heavy-duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

D. Rated: Horsepower rated, 250-volt as required by the particular circuit with ampere rating and number of poles as indicated, or as required by the specific equipment.

E. Enclosures: NEMA KS 1; Type 1 for interior dry locations, Type 3R raintight for exterior locations. Type 4 gasketed for wash down areas in kitchens.

2.2 FUSES

A. Acceptable Manufacturers:
1. Bussman.
2. Gould Shawmut.
3. Littelfuse.

B. Fuses 600 Amperes and Less: Dual element time delay current limiting Class RK5 (Dual Element Time Delay); 250 volt.

C. Interrupting Rating: 200,000 RMS amperes.

2.3 FUSE CABINET:

A. Fuse Cabinet: Sized to contain all spare fuses required plus 25% room for future use. Provide with engraved nameplate.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. See Section Division 26 260180 “Equipment Wiring.”

B. Install fuses in fusible disconnect switches.

C. Mount fuse cabinet in main electrical room.

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SECTION 260470 – PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Panelboards.

B. Individually mounted circuit breakers.

C. Metering

1.2 RELATED SECTIONS

A. Division 01 Section "Submittal Procedures."

B. Division 06 Section "Rough Carpentry."

C. Division 09 Section "Painting."

D. Division 26 Section 260010: Basic Electrical Requirements.

E. Division 26 Section 260170: Grounding and Bonding.

1.3 REFERENCES

A. NEMA Standards.

B. NFPA 70 N.E.C. Latest Edition.

C. U.L. Standards.

1.4 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70 (N.E.C.).

B. Furnish products listed and classified by Underwriters Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

C. Size per Drawings.

1.5 SUBMITTALS

A. Submit Shop Drawings, Owners' Manuals, and Operating Instructions in accordance with Division 01 Section "Submittal Procedures."

B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker arrangement, catalog, specification and sizes, panel dimensions, and gutter space.

1.6 SPARE PARTS

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A. Keys: Furnish to Owner 1 key for each panel. All panels shall be keyed alike.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURES - PANELBOARDS

A. General Electric.

B. Eaton.

C. Siemens.

D. Schneider Electric (Square D).

2.2 PANELBOARDS RATED 400AMPERE AND LESS

A. Circuit breaker type with mains and circuits as indicated on the Drawings and designed for one phase, three wire or three phase, four wire, solid neutral, 60 cycle service rated for 120/208 volt service as scheduled.

B. Enclosure: NEMA Type 1 except as noted. Code gauge galvanized steel boxes and enameled steel fronts sized for 6" minimum side, top and bottom gutters, or greater as required by NEC.

C. Flush or surface mounting as indicated by the panel schedule, concealed hinge and flush lock all keyed alike.

D. Bus: Copper ratings as scheduled on Drawings. Provide subfeed and feed-through lugs as required. Lugs designed for use for both copper and aluminum conductors. Subfeed shall signify that lugs are tapped ahead of buses and feed-through shall signify that lugs are tapped on load side of the main and buses.

E. Neutral Bar: Copper, full size insulated from the cabinet and provided with lugs for each branch circuit space in the panel.

F. Bonding strap securely attached to the cabinet with lugs as required to receive the bonding conductors indicated and specified.

G. Minimum Integrated Short Circuit Rating:
   1. As indicated on drawings

H. Molded Case Circuit Breakers: Toggle type thermal-magnetic, quick-make, quick-break, with silver-plated contacts, bolt-in type, and with common trip for multiple circuits. Breakers shall have a nominal thickness of 1" per pole. Provide circuit breakers UL listed as Type SWD for switching lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where indicated.

I. Bedroom Circuit Breakers: UL listed as Arc-Fault Circuit Interrupter.

2.3 INDIVIDUALLY MOUNTED CIRCUIT BREAKERS

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A. Molded Case Circuit Breakers: As specified above for Panelboards.

B. Enclosure: NEMA Type 1 general purpose except as noted.

C. Flush or surface mounted as indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards plumb and properly secured. Recessed panels shall be flush with wall finishes.

B. Height: Per N.E.C.

C. Provide filler plates for unused spaces in panelboards.

D. Provide typed directory completely filled-in indicating outlets, fixtures, devices, and locations served by the circuit. Revise directory to reflect circuiting changes required to balance phase loads.

E. Stub 4 empty one inch conduits to accessible location above ceiling and below floor, from each recessed panelboard that has accessible ceilings above and/or below the panel.

F. Finish painting of flush panelboards and individually mounted breakers shall be as specified in Division 09 Section "Painting".

G. Properly support backboards, and panels. At non structural walls, provide separate support system for panelboards and equipment. Use UNISTRUT P5000 channels or equal. Length and spacing to form rigid separate wall. In other areas, coordinate with Division 06 Section "Rough Carpentry", to provide blocking as required.

3.2 FIELD QUALITY CONTROL

A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

3.3 PANELBOARD SCHEDULE

A. See Drawings.

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SECTION 260510 – LUMINAIRES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior and exterior luminaires and accessories.

B. Exterior luminaires and accessories.

C. Ballasts.

D. Lamps.

E. Additional wiring methods for luminaires.

1.2 RELATED SECTIONS

A. Division 26 Section 260010: Basic Electrical Requirements.

B. Division 26 Section 260111: Conduit.

C. Division 26 Section 260123: Wire and Cable.

D. Division 26 Section 260130: Boxes.

E. Division 26 Section 260170: Grounding and Bonding.

F. Division 26 Section 260141: Wiring Devices. (for self contained local controls)

1.3 REFERENCES

A. NEMA Standards.

B. NFPA 70 N.E.C. Latest Edition.

C. U.L. Standards.

D. ANSI/NFPA 101 - Life Safety Code.

1.4 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70 (N.E.C.).

B. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

1.5 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section “Submittal Procedures”.

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B. Shop Drawings: Indicate dimensions and components for each luminaire that is product of the manufacturer.

C. Product Data: Provide dimensions, ratings, performance data and total input wa

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site. Inspect for damage.

B. Protect from moisture, corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.7 SPARES

A. Provide two replacement lamps for each lamp type installed.

1.8 PROJECT CONDITIONS

A. Wiring to fixtures as shown on Drawings is diagrammatic only and is intended to show circuit and switching arrangements. Fixtures shall not be used as raceways except as specifically allowed by N.E.C. Art 410.

B. Where panel designation and circuit numbers are shown with no homerun symbol, wiring to same circuits may share same homerun to panel. See voltage drop and distance restrictions in Division 26 Section 260010.

PART 2 - PRODUCTS

2.1 LUMINAIRES

A. Furnish products as specified in schedule on Drawings.

B. All fixtures shall be approved by Underwriters' Laboratories, Inc., and bear Underwriters' labels.

C. In addition to the manufacturers listed on the Drawings, fixtures with equivalent details and matching characteristics as provided by manufacturers listed below shall be considered for approval after review of Shop Drawings.

D. Manufacturers:

Halo	Exceline	Insight Lighting	Moldcast
Columbia	Holophane	Keystone	Peerless
Exceline	Hubble	KIM	QL
Cooper	ICE (ICON)	Lightolier	Spaulding
Daybrite	Keene	Litecontrol	SPI
Delta	Benjamin	Lithonia	Winona

E. Ballast: Provide ballast suitable for lamp specified.

F. Lamps: All lamps shall be furnished and installed in each fixture.

2.2 BALLASTS: Rated 120 volts or as noted.

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A. Ballast Manufacturers:
   1. Valmont.
   (1) Osram/Sylvania.
   2. Universal Lighting Technologies.
   3. Magnetek.
   4. Jefferson.
   5. Advance.

B. T8 and T5HO linear lamp Fluorescent Ballast:
   1. Fully electronic 25,000 Hz programmed start, two, three and four lamp type. Quantities to allow switching as indicated on plans. Provide only rapid start lamps which are specifically designed to operate properly on instant start electronic ballasts.
   2. Ballasts for all recessed fixtures shall be of the very low heat (VLH) design.
   3. Total harmonic distortion shall be less than 15%.
   4. Ballast Factor Shall be Normal (minimum 0.88).
   5. Where fixtures run end to end, or are within the standard 11 foot ballast whip distance, then efforts shall be made to utilize as many four lamp ballasts as possible (driving four lamps). In all cases, ballasts shall be installed to drive the exact number of lamps they are designed for, Example - one lamp ballast drives one lamp, two lamp ballast drives two lamps, etc. Installation where this criteria is not followed will not be accepted.
   6. Where fixtures can use 11 foot whips (master and satellite pairs), ballast shall be installed to drive the exact number of lamps indicated and fixture shall be provided with pre-manufactured ballast whips.

2.3 LAMPS

A. Lamp Manufacturers:
   1. Sylvania/Osram.
   2. Philips.
   3. Venture Lighting International.
   4. General Electric.

B. Fluorescent Lamps: T8 (2900 lumen) as scheduled, Energy saving 3500K, designed to operate properly when driven by ballasts indicated on the schedule and ballasts as specified herein.

C. All Lamps shall be low mercury and non-hazardous, and shall pass the EPAs Toxicity Characteristic Leaching Procedure (TCLP) for the purpose of disposal.

D. Incandescent Lamps: Rated 130 volt.

E. Provide lamp types specified for luminaire.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Complete with 660 watt sockets, wiring, ballasts, stems, hangers, fittings, end plates, pendant feeds, etc.

B. Install in accordance with manufacturer's instructions.

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C. Suspended Luminaires.
   1. Pendants:
      a. Provide pendant length required to suspend luminaire at indicated l
         lengthened to give mounting heights as indicated and required.

D. Locate recessed ceiling luminaires as indicated on reflected ceiling plan. Fixture
frame and trim details to match the ceiling suspension system furnished. Coordinate details with Acoustical Treatment Section and installation with the Ceiling Installer to assure fixtures are centered on tiles or on joints as required.

E. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Install spacers where required to allow proper installation of rabbeted (Tegular) ceiling tiles. Secure to prevent movement.

F. Install clips to secure recessed luminaires in place. Install recessed luminaires to permit removal from below.

G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

H. Install wall mounted luminaires at height as indicated.

I. Install accessories furnished with each luminaire.

J. Additional Wiring Methods For Luminaires:
   1. Refer to Division 26 Section 260010 - Basic Electrical Requirements: Performance Requirements.
   2. Refer to Division 26 Section 260123 - Wire and Cable: Wiring Methods.
   3. Recessed and surface incandescent fixtures: Wiring rated minimum 300E F in metallic conduit where required for Underwriters' approval.
   4. Fluorescent Fixtures: Wiring within housings and between fixtures and junction boxes above ceilings shall be Type THHN insulated conductors rated for use at temperatures not lower than 90ºC.
   5. Wiring From Recessed Fixtures To Junction Boxes: As described in Division 26 Section 260010 “Basic Electrical Requirements”: Performance Requirements.

K. Bond products and metal accessories to branch circuit equipment grounding conductor.

L. Install specified lamps in each luminaire.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Locate fixtures to avoid interference with mechanical and structural features.

B. In finished spaces, consult the Architect prior to making adjustment to fixture locations.

3.3 FIELD QUALITY CONTROL

A. All fixtures and equipment shall be in first-class condition at time of delivery of building to Owners with all scratches, mars, etc., refinished to factory standards.

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B. Operate each luminaire after installation and connection. Inspect for proper con operation.

3.4 ADJUSTING/CLEANING/RELAMPING

A. Aim and adjust luminaires after dark as directed.

B. Relamp luminaires whose lamps have failed at Substantial Completion and six (6) months thereafter.

C. Clean electrical parts to remove conductive and deleterious materials.

D. Remove dirt and debris from enclosure.

E. Clean photometric control surfaces using procedures as recommended by manufacturer.

F. Clean finishes and touch up damage.

3.5 SCHEDULE

A. Shown on Drawings.

END OF SECTION 260510

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SECTION 260535 – EMERGENCY LIGHTING EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Emergency lighting battery units.

B. Exit signs.

1.2 RELATED WORK

A. Section 260010: Basic Electrical Requirements.

B. Section 260111: Conduit.

C. Section 260123: Wire and Cable.

D. Section 260130: Boxes.

E. Section 260170: Grounding and Bonding.

F. Section 260510: Luminaires.

1.3 REFERENCES

A. NEMA Standards.

B. NFPA 70 (N.E.C.) Latest Edition.

C. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.

D. U.L. Standards.

E. ANSI Standards.

1.4 DESIGN REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.(N.E.C.)

B. Conform to local building code and NFPA 101 for installation requirements.

C. Furnish products listed and classified by Underwriters Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

D. All components of the same manufacturer.

1.5 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Section 013300.

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B. Include all components, electrical characteristics, recommended maintenance pr intervals, list of each battery unit and the total device count and load on each uni

C. Submit manufacturer's instructions.

1.6 WARRANTY

A. Fully guaranteed for a minimum of three (3) years. Except as noted, batteries shall be warranted for an additional seven (7) years minimum, on a prorated basis with a life expectancy of ten (10) years.

1.7 PROJECT RECORD DRAWINGS

A. Mark on the “AS-Built Drawings” the circuit numbers controlling the emergency lighting and exit signs next to each fixture.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Lithonia: Model numbers listed except as noted.

B. Lightalarms.

C. Sure-Lites.

D. Chloride.

E. Dual-Lite.

F. Siltron.

G. Prescolite.

H. Dynaray.

2.2 EMERGENCY LIGHTING BATTERY UNITS

A. 12 volt, D.C. complete with cabinet of minimum #18 gauge steel or high-impact "NORYL" thermoplastic, sealed maintenance free lead-calcium battery, automatic solid state or two-pole type transfer relay, high and low rate charging, ampere and volt meters, lamp disconnect switch, test switch.

B. Batteries: Sufficient capacity to supply and maintain at not less than 87-1/2 percent of system voltage the total lamp load indicated for a period of time as required by latest edition of NEC,(90 minutes minimum). Initially oversize to meet this criteria over battery's entire life.

C. Unit Voltage: 120 volts, AC.

D. Unit Mounted and Remote Heads: 9 watt sealed beam MR16 Halogen type in NORYL high

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impact thermoplastic black housing.

E. Sure-Lites CC5 series with black housing. Lamp #029-84.

2.3 EXIT SIGNS

A. Universal LED type Self powered, complete with ceiling, side wall brackets and arrows and faces as indicated. Brown out, low voltage disconnect, test switch, power indicator.

B. Die-cast aluminum construction white Face and Red letters.

C. Red LED=s Smooth look and no visible LED dots. Less than 3Watts input power.

D. Nickel Cadmium Battery with 15 year pro rated warranty.

E. Sure-Lite CX7 Series.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units plumb and level.

B. Aim directional lampheads to maximize light in egress paths and as directed.

C. AC Wiring to Exit Lights: In separate conduit, or MC cable with ground.

D. Exit Sign Mounting: Generally mount directly above and centered over the doorway opening, on the wall where possible, or mounted from the ceiling when wall mounting is not possible. End wall mounted where required, up 7'-6" AFF. The intent is to locate signs to allow for maximum visibility. Consult Architect before installation, if in question.

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SECTION 260721- FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Complete Addressable Fire/Burglary Alarm System including but not limited to:
   1. Equipment, materials, labor, installation, connection, programming, testing, training and performance of all operations of the intelligent reporting fire alarm system as indicated on the drawings and as herein specified.
   2. Alarm initiating devices, alarm notification appliances, fire alarm control panel (FACP), auxiliary control devices, annunciators, and wiring.
   3. Electronic digital communicator to report Fire alarm events to the owner's central receiving station for fire department notification.

1.2 RELATED SECTIONS

A. Division 26 Section "Basic Electrical Requirements."

1.3 REFERENCES

A. NFPA 70 (N.E.C.) latest edition.

B. U.L. Standards.

C. FM Factory Mutual

D. NFPA 72 National Fire Alarm Code.

E. ADA - Americans with Disabilities Act.

F. NFPA 101 - Life Safety Code.

G. Local and State Codes.

H. International Electrotechnical Commission (IEC).

I. Fire Department - Rules & Regulations for the Installation of Fire Alarm Systems.

1.4 PERFORMANCE REQUIREMENTS

A. All components shall be of the same manufacturer, FM approved and listed by Underwriters' Laboratories, Inc., and so labeled.

B. Conform to requirements of NFPA 70. (N.E.C.), specifically Art 760.

C. Conform to requirements of the National Fire Protection Association, Standards NFPA 72 NFPA 101 and also all applicable Federal, State and local codes.

D. Conform to all requirements of the Authority Having Jurisdiction (AHJ).

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E. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L purpose specified and shown. The fire alarm control panel, network interface an shall meet the modular labeling requirements of U.L. Each subassembly, incl circuits, shall include U.L. modular labels.

F. Include all necessary software, programming and the selection of the proper type the system components to assure a complete, operational, and Code Compliant System.

G. Where the effect of more than one strobe is visible in one location (including reflected light), then configure the system to synchronize the strobes.

H. System shall be field programmable.
   1. Provide the Owner with all required components, interfaces and passwords to allow them full access to the programming features. Provide minimum on site training on programming features as specified herein under PART 3 "TRAINING".
   2. Provide all hardware, software, programming tools, and documentation necessary to allow modifying the fire alarm network on site. Modifications include addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices and zones.
   3. The system structure and software shall place no limit on the type and extent of ON-SITE software modifications. Software modification shall not require power shut down of system and shall not cause loss of system fire protection while making modifications.

I. Special Programmable Features:
   1. HVAC units: Interface shall be field programmable to allow shut down activation on general alarm and/or on selective zoning of local detectors. Set initially to shut down on general alarm. For all HVAC equipment that is required to be shut down upon a fire alarm condition, ensure that fire alarm shutdown of equipment is wired through input contacts within the starter enclosure. Upon receipt of an alarm signal from the building's fire alarm system, the motor controller shall be given a command to shut down the motor. Circuitry shall be provided to ensure that the motor is shut down whether the controller is in the "AUTO", "HAND" or "BYPASS" mode. If this feature is not available from the equipment manufacturer, then Division 23 shall be responsible for providing a contactor on the line side of the starter to accomplish the same function.
   2. HVAC Duct Smoke Dampers: Interface shall be field programmable to allow activation on general alarm and/or on selective zoning of local detectors. Set initially to close dampers on general alarm.

J. The drawings do not show all components, devices and details of the Fire Alarm System. It shall be the responsibility of the authorized supplier/installer to provide full documentation and to provide a fully operational code compliant system.

K. Coordinate with and obtain approval from the local Fire Chief (AHJ), prior to the Shop Drawing submittal. See Item Submittals.

1.5 SYSTEM DESCRIPTION

A. Fire/Burglary Alarm System: Addressable automatic and manual initiating with audio visual notification, intelligent reporting, microprocessor controlled fire detection/alarm system.

B. An active/interactive type system where each addressable device is repetitively scanned, causing a

signal to be transmitted to the local fire alarm control panel node indicating that associated initiating devices and notification appliance circuit wiring is functio signal at the local FACP shall result in a trouble indication on both the FACP c network display.

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C. System Performance and Supervision:
   1. Alarm, trouble and supervisory signals from all intelligent reporting devices: Encoded on NFPA Class A) signaling line circuits (SLC).
   2. Initiating device circuits (IDC): Wired class A NFPA Style D as part of an addressable device connected by the SCL circuit (end of line returns to the panel using a separate path).
   3. Notification appliance circuits (NAC): Wired class B.
   4. Digital electronic signals: Employ check digits or multiple polling.
   5. Occurrence of single ground or open condition in initiating or signaling circuit places circuit in TROUBLE mode.
   6. Occurrence of single ground or open condition in the initiating circuit does not disable any device on that circuit.
   7. Occurrence of single ground or open condition on alarm initiating or signaling circuits does not disable that circuit from transmitting in ALARM.
   8. Component or power supply failure places system in TROUBLE mode.
   9. Alarm signals arriving at the main FACP shall not be lost following a primary power failure until the alarm signal is processed and recorded.
   10. Batteries: Under or over battery voltage, shorted or disconnected battery supply places system in TROUBLE mode.
   11. FACP devices are to consist of low current, solid-state integrated circuits, and shall be powered locally from a primary power and standby power source.
   12. Power for initiating devices and notification appliances shall be from the main fire alarm control panel, the FACP to which they are connected or to a Field Charging Power Supply (FCPS).
   13. Notification appliance circuits shall have 25 percent spare capacity.

D. Alarm Sequence of Operation: Actuation of manual fire alarm station, automatic initiating device and sprinkler flow switches causes system to enter ALARM, which includes the following operations:
   1. Disable local sound systems. Provide interfacing relays as required to assure that local programs will not obscure the fire alarm audible devices. Coordinate with the successful sound system vendor to assure proper operation. Provide relays with separate isolated contacts at each sound system amplifier to provide a signal to power down the sound system amplifier upon activation of a fire alarm condition. Where the sound system amplifier does not support remote shutdown of the amplifier provide a contactor (min 20 ampere rated) to interrupt the power feed to the sound system amplifier.
   2. Indicate location of alarm on fire alarm control panels for all events.
   3. Indicate on FACP LCD display.
   4. Energize a digital electronic communicator to send a message to the Owner's central receiving station.
   5. Activate all programmed events.
   6. Sound and display throughout the building the fire alarm (horn/light) signaling devices.
   7. See Special Programmable Features for additional requirements.

E. Alarm Silence: Configure the system such that the alarm horns/speakers may be silenced, after three (3) minutes, at the associated locked FACP control cabinet. Alarm strobes shall remain flashing

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until system is reset. A subsequent alarms shall reactivate the signals.

F. Alarm Reset: RESET function resets alarm system to NORMAL condition (ou alarm initiating circuits have cleared.

G. Trouble Sequence of Operation: System trouble, including grounding or open cir circuits, or power or system failure causes system to enter TROUBLE mode, including the following operations:
   1. Visual and audible trouble alarm at associated control panel.
   2. Manual ACKNOWLEDGE function (trouble silence switch) at control panel, silences audible trouble alarm; visual alarm is displayed until initiating trouble is cleared.

H. The activation of any system smoke detector shall initiate an Alarm Verification operation whereby the panel resets the activated detector and waits for a second activation. If, after reset, a second alarm is reported from the same or any other smoke detector within one (1) minute the system shall process the alarm. If no second alarm occurs within one minute the system shall resume normal operations. The Alarm Verification shall operate only for smoke detectors. Other activated initiating devices shall be processed immediately.

I. Zoning: Programmable set up and program as direct by Owner and Local Fire Department.

1.6 QUALIFICATIONS

A. Fire alarm equipment Manufacturer:
   1. Company specializing in manufacturing the products specified in this Section with minimum five years documented experience.
   2. Company maintaining engineering and service departments capable of rendering advice regarding installation and final adjustment of the system.

B. Supplier/Installer (Vendor):
   1. Company authorized by the manufacturer and specializing in fire alarm systems with minimum five years' experience.
   2. Company shall employ NICET (minimum Level II fire alarm technology) technicians.
   3. Provide the services of a factory trained and certified representative or technician, experienced in the installation and operation of the type of system provided.
   4. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation and maintenance.
   5. The equipment supplier shall be authorized and trained by the manufacturer to calculate, design, install, test, and maintain the system.
   6. Company offering service contracts for continuing factory authorized service after the initial warranty period.

1.7 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section "Submittal Procedures".

B. Prior to submitting Shop Drawings to the Architect, set up a meeting at the Local Fire Department with a complete submittal package. Vendor shall present the proposed system to the Fire Department and describe in detail, the operation. Once the fire department is satisfied that the proposed system

meets their requirement (including locations of ADA required Strobes), then the sh
be submitted to the Architect along with a copy of the minutes of the meeting. Sh
not be reviewed by the Architect without this presentation and minutes of the me

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C. Include floor plan layout and system riser showing all components, devices, wiring, connections:
   1. For floor plan layout, use contract drawing.
   2. Electronically mark-up showing all wiring between devices, number of conductors, and labeling system.
   3. Shop drawings will not be reviewed by the Architect without these drawings.

D. Include proposed wiring color code and verification that it meets local fire department standards.

E. Include letter verifying that system has been reviewed and approved by the local Fire Department.

F. Include narrative description of system functions and sequence of operation.

G. Include connection diagrams and catalog cuts of all components, including all equipment, devices, annunciator layout, control panel modules, and internal terminal configurations.

H. Include documentation showing proof of U.L. listing for all system components.

I. Include a fire alarm system function matrix as referenced by NFPA 72. Matrix shall illustrate alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions.

J. Include Power calculations and Battery capacity calculations. Provide the following supporting information:
   1. Total panel supervisory current.
   2. Total horn/strobe signal current.
   3. Total auxiliary power.
   4. Total smoke detector supervisory and alarm power.
   5. Total battery amp-hour calculations.
   6. Voltage drop on each notification appliance circuit (NAC voltage drop at each appliance).
   7. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst-case condition plus 25 percent spare capacity.
   8. NAC circuit design shall incorporate a 25 percent spare capacity for future expansion.
   9. Battery size shall be a minimum of 125 percent of the calculated requirement.

K. Include all cable types.

L. Include second year extended service contract listing services included and costs. The cost of this service contract is included under this section.

M. Submit manufacturer's instructions.

N. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On portable media (jump drive/compact disk), complete with data files.

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3. Device address list.
4. Printout of software application and graphic screens.

O. Product Data: For each type of product:
1. Include construction details, material descriptions, dimensions of individua profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Complete manufacturer's catalog data including supervisory power usage, alarm power usage, physical dimensions, and finish and mounting requirements.

P. See additional requirement specified in PART 1 under "PERFORMANCE REQUIREMENTS"

1.8 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations and mounting heights of outlets if not as shown on Drawings, plus pull and junction boxes larger than 12x12x6 inches.

B. Accurately record actual routing of conduits larger than 1 inch and main wiring trunks.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

C. Include operating instructions, and maintenance and repair procedures.

D. Include manufacturer's representative's letter stating that system has been tested and is operational. Use NFPA 72 FIRE ALARM SYSTEM CERTIFICATION and DESCRIPTION form.

1.10 EXTRA MATERIALS

A. Provide one manual pull stations.

B. Provide two keys of each type.

C. Provide one smoke detector of each type.

D. Provide one duct smoke detector of each type with housing.

E. Provide two heat detector of each type.

F. Provide two Horn/Strobes and two adjustable Cd Strobes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Honeywell: Addressable system. Model numbers used except as noted.

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B. The following manufactures with Systems having equivalent features and ca considered for approval:
   1. Edwards.
   2. Siemens.
   3. Notifier.

2.2 CONTROL PANELS

A. Fire alarm control panel shall be Honeywell Vista 128FBP series. Provide all necessary modules for a complete operational system. Panel shall include a microprocessor based central processing unit (CPU). The FACP shall communicate with and control the following types of equipment used to make up the system: intelligent detectors, addressable modules, control circuits, notification appliance circuits, transponders, local operator terminals, and other system controlled devices. The control panel shall be an eight (8)-partition, UL commercial fire and burglary control panel that provides 128 zones using basic hardwired, polling loop, and wireless zones. It shall also provide supervision of two (2) notification appliance output circuits (NAC), RF receivers, and relay modules. In addition, the control shall provide the ability to schedule time-driven events, and allow certain operations to be automated by pressing a single button. The system shall be capable of interfacing with an ecp long-range radio (LRR) unit that can send Contact ID messages, and alphanumeric paging devices. The control shall provide integrated access control and CCTV-switching capability with the use of a single downloader and database.

B. FACP shall perform the following functions:
   1. Supervise and monitor all intelligent/addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
   2. Supervise all signaling and notification circuits throughout the facility.
   3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.
   4. Visually and audibly annunciate any trouble, supervisory and alarm conditions on operator's terminal, panel display, and annunciators.

C. Capacity and General Operation:
   1. Listed for UL Commercial Fire and Burglary.
   2. Supports up to 128 zones.
   3. Supports up to eight (8) separate partitions.
   4. Supports up to 150 users.
   5. Supports commercial wireless devices.
   6. Provides integrated security, access control, and CCTV switching and commercial fire capability.
   7. Provides supervision of peripheral devices.
   8. Supports up to 96 optional relay outputs.
   9. Supports long-range radio (LRR) communication.
   10. Provides scheduling capability to allow for automated operations.
   11. Supports up to eight (8) alphanumeric paging devices.
   12. Supports panel linking.
   13. Supports alarm reporting via Internet.
   14. Interfaces with automation software.
   15. Monitors smoke detector maintenance signals.

D. Polling loop (Expansion Zones):
   1. Polling Loop - The control shall support up to 120 additional hardwire zones using a built-in

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two-wire polling (multiplex) loop interface. The polling loop shall provide remote point modules, and constantly monitor the status of all zones on the current draw shall not exceed 128 mA. The polling loop zones shall ha characteristics:

a. Interface with RPM (Remote Point Module) devices that provide (e.g., 4208U/4208SN) or a combination of Class B, Style Y, and (e.g., 4208SNF) zones.
b. Individually assignable to one of eight (8) partitions.
c. Individually assignable to NAC outputs or auxiliary relays.
d. Supervised by the control panel.
e. A 12,000 ft (3658 m) wire run capability without using shielded cable.
f. Each RPM (Remote Point Module) enclosure shall be tamper protected.

2. Wireless Expansion - The control shall support up to 128 wireless zones using a 5800 series RF receiver (fewer if using hardwire and/or polling loop zones). Wireless zones shall have the following characteristics:
   a. Supervised by control panel for check-in signals (except certain non-supervised transmitters).
   b. Tamper-protection for supervised zones.
   c. Individually assignable to one of the partitions.
   d. Individually assignable to bell outputs and or auxiliary relays.
   e. Support wireless devices listed for Commercial Burglary using the 5881ENHC RF Receiver.

3. Partitions - The control shall provide the ability to operate eight (8) separate areas, each functioning as if it had its own control. Partitioning features shall include:
   a. A Common Lobby partition (1-8), which can be programmed to perform the following functions:
      1) Arm automatically when the last partition that shares the common lobby is armed.
      2) Disarm when the first partition that shares the common lobby is disarmed.
   b. A Master partition (9), used strictly to assign keypads for the purpose of viewing the status of all eight (8) partitions at the same time (master keypads).
   c. Assignable by zone.
   d. Assignable by keypad/annunciator.
   e. Assignable by relay to one or all eight (8) partitions.
   f. Ability to display fire and/or burglary and panic and/or trouble conditions at all other partitions' keypads (selectable option).
   g. Certain system options selectable by partition, such as entry/exit delay and subscriber account number.

4. User Codes - The control shall accommodate 150 user codes, all of which can operate any or all partitions. Certain characteristics must be assignable to each user code, as follows:
   a. Authority level (Master, Manager, or several other Operator levels). Each User Code (other than the installer code) shall be capable of being assigned the same or a different level of authority for each partition that it will operate.
   b. Opening/Closing central station reporting option.
   c. Specific partitions that the code can operate.
   d. Global arming capability (ability to arm all partitions the code has access to in one command).
   e. Use of an RF (button) to arm and disarm the system (RF key must first be enrolled into the system).Each CPU shall contain and execute all control-by-event interlock for specific local and network action to be taken if an alarm condition is detected by the system. Control-by-event programs shall be held in non-volatile programmable

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memory, and shall not be lost even if system primary and second occurs.

5. Peripheral Devices - The control shall support up to 30 addressable ECP d be any combination of keypads, RF receivers, relay modules, annuncia interactive phone modules. Peripheral devices have the following charact
   a. Each device set to an individual address according to the device's i
   b. Each device enabled in system programming.
   c. Each device's address shall be supervisable (via a programming option).
6. Keypad/Annunciator - The control shall accommodate up to 16 keypads or six (6) touch-screen (i.e.; advanced user interface) keypads. The keypads shall be capable of the following:
   a. Performing all system arming functions.
   b. Being assigned to any partition.
   c. Providing four programmable single-button function keys, which can be used for:
      1) Panic Functions -activated by wired and wireless keypads; reported separately by partition.
      2) Keypad Macros -32 keypad macro commands per system (each macro is a series of keypad commands). Assignable to the A, B, C, and D keys by partition. Consistent with UL864 standards, the CPU and associated equipment shall be protected against voltage surges and line transients.
7. Output Relays - A total of 96 relay outputs shall be accommodated using relay modules. Each relay module shall provide four (4) Form C (normally open and normally closed) relays for general-purpose use or two (2) Class-B, Style-Y supervised notification appliance circuit outputs, when using the 4204CF module. The relays shall be capable of being:
   a. Programmed to activate in response to system events.
   b. Programmed to activate using time intervals.
   c. Activated manually using a relay command mode.
   d. Assigned an alpha descriptor.
   e. Used for Class B, Style-Y supervised bell outputs (4204CF module).
   f. A combination of 4204 (ECP) and 4101SN (polling loop) relays.
8. Vista Interactive Phone Module - The control shall support the ADEMCO 4285/4286 VIP Modules, which permit access to the security system in order to perform the following functions:
   a. Obtain system status information.
   b. Arm and disarm the security system.
   c. Control relays.
9. LED Annunciator - The control shall support the Honeywell ADEMCO FSA-8 and FSA-24 annunciators, which are capable of:
   a. Visually identifying a zone or point that is in alarm or trouble.
   b. Programmable for system silence/reset.
   c. Up to 96 LEDs may be used in one system.
   d. A total of four (4) FSA-24 or 12 FSA-8 annunciators may be used in one system.
   e. An optional keyswitch, FSAKSM module, shall be available for UL listed Silence and Reset capability.
10. Notification Appliance Circuits (NAC) - The Control Panel shall internally provide two supervised NAC outputs for operating fire and burglar alarm notification appliances. It shall also support additional supervised bell outputs when using 4204CF relay modules. Each NAC output shall be rated at 10-14 VDC, 1.7 amp max power limited. Total alarm current draw when using two NAC outputs shall not exceed 2.3 amps for battery independent operation.
11. Auxiliary Relay - A built-in Form C relay shall be provided. The relay contacts shall be rated at 28 VAC/VDC, 2.8 amps maximum. The relay shall support:
   a. Alarm activation.
   b. Trouble/supervisory activation.

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c. Reset of four-wire smoke detectors.
d. Battery saving feature.

12. Integrated Access Control - The control shall be capable of the following:
    a. Providing a command that activates relays to allow access doors to door), lights to be turned on or off, etc.
    b. Becoming a fully integrated access control system by using numerous Door Access Control Modules.
    c. Supporting up to eight (8) VistaKey Access Control Modules. The VistaKey Access Control Modules shall use the same Compass Downloader as the Vista-128FBP and shall be programmable from the Compass Downloader or the Keypad/Annunciators.
    d. Assigning any number of access control relays to each partition (up to 96 for the system).
    e. Supporting up to 250 access card holders using VistaKey.
    f. Connecting to the ADEMCO PassPoint Access Control System via the Vista Gateway Module (VGM).
13. CCTV Switching - The System shall be capable of supporting the VistaView 100 CCTV Switching System. The CCTV system shall be fully integrated and be event driven by Fire, Burglary or Access events. When cameras are not event driven, they shall be driven by an automatic preset dwell time. The system shall also be capable of:
    a. Activating the CCTV system via a Form-C relay output.
    b. Operating up to 60 camera inputs and 30 video outputs.
14. Commercial Wireless Equipment - The Control shall be compatible with UL Listed Commercial Wireless Fire & Security equipment including:
    a. Honeywell ADEMCO 5881ENHC Commercial Fire/Burg Receiver. - The receiver shall be capable of receiving as many points as the control panel is rated for. Up to two (2) receivers may be used on any system. Receivers may be remotely located anywhere on the system Keypad/Annunciator bus.
    b. Honeywell ADEMCO 5808LST Wireless Photoelectric Smoke and Heat Detector - The device shall be UL 268 listed and shall have Maintenance Alert capability and Automatic Drift Compensation.
    c. Honeywell ADEMCO 5809 Wireless 135D Fixed Temperature and Rate of Rise Heat Detector - The device shall be UL 521 listed for commercial applications.
    d. Honeywell ADEMCO 5817CB Wireless Universal Contact Monitoring Transmitter - This device shall be capable of making any conventional UL listed contact device a wireless device. The device shall be UL listed for commercial fire and burglary applications as follows: UL 864, 985 for fire and UL 365, 609, 1023, 1076 and 1610 for security and nurse call.
    e. Honeywell ADEMCO 5869 Wireless Hold Up Switch/Transmitter - This device shall be UL 636 listed for commercial burglary applications.
15. Keyswitch - The control shall support the Honeywell ADEMCO 4146 Keyswitch on any one of the system's eight (8) partitions. If used, zone 7 is no longer available as a protection zone.
16. Voltage Triggers - The system shall provide voltage triggers, which change state for different conditions. Used with long-range radio (LRR) equipment or other devices such as a remote keypad sounder, keyswitch ARMED and READY LEDs, or a printer to print the system's event log.
17. Event Log - The System shall maintain a log of different event types (enabled in programming). The event log shall provide the following characteristics:
    a. Stores up to 512 events.
    b. Viewable at the keypad or through the use of Compass software.
    c. Printable on a serial printer using a 4100SM Module including zone alpha descriptors.
    d. Stores PassPoint access control events.
    e. Sends printed events to up to eight (8) alphanumeric pagers.

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18. Scheduling - Provides the following scheduling capabilities:
    a. Open/close schedules (for control of arming/disarming and reportir
    b. Holiday schedules (allows different time windows for open/close s
    c. Timed events (for activation of relays, auto-bypassing and un-bypas and disarming, etc.).
    d. Access schedules (for limiting system access to users by time)
    e. End User Output Programming Mode (provides 20 timers for relay control).
    f. The system shall automatically adjust for daylight savings time.
19. Communication Features - Supports the following formats and features for the primary and secondary central station receivers:
    a. Formats:
        1) ADEMCO Low Speed (Standard or Expanded).
        2) Sescoa/Radionics.
        3) ADEMCO Express.
        4) ADEMCO High Speed.
        5) ADEMCO Contact ID.
    b. Backup reporting - The system shall support backup reporting via the following:
        1) Secondary phone number.
        2) ECP long-range radio (LRR) interface.
        3) Option to select long range radio (LRR) or dialup as the primary reporting method (dynamic signaling feature).
    c. Internet reporting - The system shall be capable of communicating with the central station via the internet using Alarmnet-i. It shall shall provide the user with the ability to control the system via a browser interface (i.e., AOL, Netscape, Internet Explorer). All packet data transmitted to the monitoring station shall be encrypted with a minimum of 1024 bits of encryption.
20. Audio Alarm Verification Option - Provides a programmable Audio Alarm Verification (AAV) option that can be used in conjunction with an output relay to permit voice dialog between an operator at the central station and a person at the premises.
21. Cross-Zoning Capability - Helps prevent false alarms by preventing a zone from going into alarm unless its cross-zone is also faulted within five (5) minutes.
22. Pager Interface - The Control Panel shall be capable of sending event information to an alphanumeric pager via a VA-8201 pager interface device.
23. Power Supply - The Control Panel shall be compatible with a power supply module. The module shall supply two (2) rectified, unfiltered outputs, which power:
    a. Alarm notification appliances, including but not limited to sirens horns, bells and strobes.
    b. Auxiliary devices capable of operating using full-wave rectified unfiltered voltage.
24. Exit Error False Alarm Prevention Feature - The System shall be capable of differentiating between an actual alarm and an alarm caused by leaving an entry/exit door open. If not subsequently disarmed, the control panel shall:
    a. Bypass the faulted E/E zone(s) and/or interior zones and arm the system.
    b. Generate an Exit Error report by user and by zone so the central station knows it was an exit alarm and who caused it.
25. Enhanced Fire Walk-Test Mode - The Control Panel shall provide the installer with the following features:
    a. Automatic test of all integrated remote point module (RPM) devices, equipped with an automatic test feature.
    b. While automatic test is in progress all fire zones that remain untested shall be displayed.
    c. An event log shall be capable of logging the results of tested and untested zones.
    d. The ability to report the result of tested and untested zones to the central station.

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26. Built-in User's Manual and Descriptor Review - For end-user convenience, shall contain a built-in User's Manual. It shall include the following capab
    a. By depressing any of the function keys on the keypad for five (5) explanation of that function shall scroll across the alphanumeric dis
    b. By depressing the READY key for five (5) seconds, all programmed shall be displayed (one at a time). This feature shall provide a check ensure all descriptors have been entered properly.
27. Programming - The Control shall be capable of being programmed locally or remotely using the Honeywell ADEMCO Compass Downloader and shall be capable of:
    a. Uploading and downloading all programming information at 300 baud.
    b. Uploading and displaying firmware revision levels from the control.
28. Panel Linking - The Control shall be capable of being networked together with up to eight other controls and being operated by any keypad within the system. It shall provide the ability for users to:
    a. Control multiple zones, partitions, and/or buildings from a central location.
    b. Check status, arm and disarm any partition from any keypad in the system.
    c. Globally arm or disarm partitions based upon user authority.
29. Automation Software - The Control shall be capable of interfacing with automation software via an RS232 input on a single partition.

E. The control panel shall be the Honeywell (ADEMCO) VISTA-128FBP Commercial Fire/Burglary Partitioned Security System or equivalent.

2.3 ENCLOSURE

A. The Control Panel shall be enclosed in a metal cabinet, suitable for wall mounting. The dimensions shall not exceed 18 inches (45.7 cm) in height, 14.5 inches (36.8 cm) in width or 4.3 inches (10.9 cm) in depth.

2.4 ELECTRICAL POWER REQUIREMENTS

A. System Power - The Fire and Burglary Alarm System shall operate using standard 120 volts AC, 50/60 Hz power.

B. Control Primary Power - Transformer power shall be 18 VAC, 72 VA.

C. Backup Battery - A rechargeable 12 VDC, gel type, lead acid backup battery shall be provided. The battery shall be rated between 12 and 34-ampere hours (AH).

D. Alarm Power - Alarm power shall be 12 VDC, 1.7 amps for each bell output

E. Auxiliary Standby Power - Standby power shall be 12 VDC, 1 amp maximum.

F. Total Power - Combined auxiliary standby and alarm currents shall be 2.3 amps.

G. Fusing - The battery input, auxiliary, and bell outputs shall be protected using PTC circuit breakers. All outputs shall be power limited.

2.5 SYSTEM COMPONENTS - CONVENTIONAL

A. Horn/Strobes: Combination Audible/Visible signals.
    1. Electronic sounders shall produce a sound level of at least 90 dBA measured at 10 feet from the device.

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2. Ability to silence the horn while leaving the visible signal active.
3. Capable of meeting the candela requirements of ADA.
4. Polarized to allow electrical supervision.
5. Candela ratings: Selectable 15, 30, 75, 110, with visual indicator.
6. Set strobe candela initially as shown on drawings and as recommended b technician.
7. Where drawings show 15/75, then use a fixed 15/75 or set selection at 75.
8. Where more than one strobe is visible in one location, synchronization shall be required.
9. Red face plate with white letters.
10. Flush mounted except in existing masonry walls. Where surface mounted, provide red matching back box.

B. Strobe lights shall meet the requirements of the ADA, UL Standard 1971 and shall meet the following criteria:
1. The maximum pulse duration shall be 2/10 of one second.
2. Strobe intensity shall meet the requirements of UL 1971.
3. The flash rate shall meet the requirements of UL 1971.
4. Where more than one strobe is visible in one location, synchronization shall be required.
5. Candela ratings: Selectable 15, 30, 75, 110, with visual indicator.
6. Set strobe candela initially as shown on drawings and as recommended by the authorized technician.
7. Where drawings show 15/75, then use a fixed 15/75 or set selection at 75.
8. Red face plate with white letters.

2.6 SYSTEM COMPONENTS - INTELLIGENT

A. Addressable Devices - General:
1. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the FACP signaling line circuit.
2. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LED's. Both LED's shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LED's shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
3. Smoke detector sensitivity shall be set in the fire alarm control panel and shall be adjustable in the field through the field programming of the system. Sensitivity may be automatically adjusted by the panel on a time-of-day basis.
4. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
5. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature.
6. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
7. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
8. Detectors shall operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby

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allowing the sensitivity of each detector to be set in the FACP program system operator to view the current analog value of each detector.

9. Addressable devices shall provide address-setting means using decimal s also store use to identify the type of device. LED(s) shall be provided that normal conditions, indicating that the device is operational and is in regula with the control panel.
10. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

B. Addressable Pull Box (Manual Station):
1. Addressable pull boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
3. Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches or larger.
4. Stations shall be suitable for surface mounting or semi-flush mounting and shall be installed not less than 42 inches, nor more than 48 inches above the finished floor.
5. Manual boxes shall be the double action type.

C. Intelligent Photoelectric Smoke Detector: The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

D. Intelligent Thermal Detectors: Thermal detectors shall be intelligent addressable devices rated at 135 deg F (58 deg C) And have a rate-of-rise element rated at 15 deg F (9.4 deg C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

E. Intelligent Duct Smoke Detector:
1. The in-duct smoke detector housing shall accommodate intelligent photoelectric detector, that provides continuous analog monitoring and alarm verification from the panel. Include sampling tube.
2. When sufficient smoke is sensed, an alarm signal shall be initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.
3. Whether shown on plans or not, all air handling systems operating at 2000 CFM and above shall have duct mounted smoke detection equipment in accordance with the requirements of NFPA 90A. See Mechanical drawings for quantities and locations of duct mounted smoke detectors.
4. Provide labeled remote test and indicating stations at the fire alarm control panel and at a visible location in the vicinity of the HVAC units.
5. Use Photoelectric type detector with duct housing and relays plus appropriate sampling tubes cut to length (width of duct).

F. Addressable Dry Contact Monitor Module:
1. Addressable monitor modules shall be provided to connect supervised initiating device circuits (IDC) zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLC loops.
2. The monitor module shall mount in a 4-inch square, 2-1/8 inch deep electrical box.

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3. The IDC zone may be wire for Style D or Style B operation. An LED shal shall flash under normal conditions, indicating that the monitor module is c regular communication with the control panel.

G. Addressable Control Module:
1. Addressable control module shall be provided to supervise and control the conventional NACs of compatible, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contact relay.
2. The control module shall mount in a standard 4-inch square, 2-1/8 inch deep electrical box, or to a surface mounted back box.
3. The control module NAC may be wired for Style Z or Style Y (Class A/B) with a current rating of 2 Amps for Style Z and 3 Amps for Style Y.
4. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply (FCPS).
5. The control module shall be suitable for pilot duty applications.

H. Addressable Relay Module:
1. Addressable Relay Modules shall be available for HVAC control and other building functions. The module shall provide two form C relays rated at up to 3 Amps resistive and up to 2.0 amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100 percent of all auxiliary devices energize at the same time on the same pair of wires.
2. For multiple relay controls a module shall be available that provides up to 6 programmable Form-C relays.

2.7 BATTERIES

A. Sealed lead calcium type capable of operation of the system under supervisory conditions for a minimum of 60 hours after power failure and capable of operating the alarm devices for 15 minutes during the 60 hour period. If batteries do not fit in control panels, then remotely mount in battery cabinet in nearest storage/mech room.

2.8 AUXILIARY DEVICES

A. Provide and install interface relays with number of poles as required (in no event less than three poles). Relays shall be Allen-Bradley, or approved equal, Bulletin 700, Type "BR" series, 120 volt coil in NEMA I enclosures. Paint enclosure red and mark "Fire Alarm Relay."

2.9 FIRE ALARM WIRE AND CABLE

A. Fire Alarm Power Branch Circuits: Specified in Section 260123 - "Wire and Cable."
1. Fire Alarm Control Panel: Provide 120 volt 20 amp dedicated circuit from nearest emergency electrical panel.
2. Remote FCPS power supplies and other devices requiring line voltage are not shown on the plans. Provide 120 volt 20 amp dedicated circuits from nearest emergency electrical panel.

B. Alarm System Wiring Within Building: Minimum size #16 AWG for initiating circuits and #14 AWG for alarm signal circuits, all copper-THWN, except as noted. Non power-limited wiring (NPLFA) and exposed wiring shall be in rigid conduit or electrical metallic tubing or flexible metal conduit in accordance with Specifications for locations used, see Section 260123 – “Wire and Cable”.

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1. Installation shall meet requirements of NEC Article 760 "Fire Alarm Syst

C. SLC Multiplex Communication Loop: Twisted shielded pair sized per manufactur conduit.

D. Telephone Circuits: Twisted shielded pair sized per manufacturer and installed

E. All wiring shall be per manufacturers recommendations for load and length required.

2.10 ENCLOSURES

A. Control panels shall be housed in UL listed cabinets suitable for surface or semi-flush mounting. Cabinets shall be corrosion protected, given a rust-resistant prime coat, and the manufacturer=s standard finish. Mount flush in finished areas.

2.11 FIREMAN'S KEY BOXES

A. Fireman's Key Boxes: Knox – Surface mounted with tamper switch and high security lock to match Fire Department standards.
   1. Hinged-door, tamper switch and where indicated, include inside switch accessory to allow operation of electric operator.
   2. Holds up to 10 keys and access cards in interior compartment.
   3. Box and lock: UL Listed.
   4. Color: Dark Bronze.
   5. Surface Mounted
   6. Quantity and locations as required by the local fire department and as indicated.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.

B. Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

3.2 PROJECT CONDITIONS

A. Installed products or materials shall be free from any damage including, but not limited to, physical abuse, dirt and debris, moisture, and mold damage.

B. Environmental Limitations: Do not deliver or install products or materials until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

3.3 INSTALLATION

A. Install system in accordance with manufacturer's instructions.

B. Wiring shall be concealed in walls and above ceilings. Wiring in exposed construction shall be

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enclosed in conduit and run along structural members and painted to match.

C. Minimum size conduit: 3/4 inch. Refer to above paragraph: FIRE ALARM WIR

D. Install manual station with operating handle 48 inches above floor. Install audible devices 80 inches above floor, or 6 inches below ceiling, whichever is lower, ex

E. Smoke detectors shall not be installed prior to system programming and testing period. If construction is on going during this period, then protect the smoke detectors from contamination and physical damage.

F. Make conduit and wiring connections to door release devices, sprinkler flow switches, sprinkler valve tamper switches, duct smoke detectors.

G. Automatic Detector Installation: Per NFPA 72.

H. Provide nameplates identifying all equipment, junction boxes and controls. Paint all junction boxes red.

I. Wiring Color Code: See Division 26 Section 260195 "Electrical Identification."

J. All devices and panels shall be flush mounted in finished areas and may be surface mounted in unfinished areas such as storage rooms. Where devices are surface mounted, the back box shall be a cast red box designed to mate with the device for a smooth appearance.

K. Wire installation shall be inspected by the fire department. Coordinate and ask for inspections from the fire department.

L. Fireman's Key Boxes: Key boxes shall be located surface mounted on the exterior of the building as shown on drawings and coordinated with local fire department and owner.

M. Factory Trained, licensed authorized technical representative of the manufacturer of the equipment shall adjust taps after installation to meet requirements.

3.4 SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for 2 years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

C. Provide 30 days' notice to Owner to allow scheduling and access to system.

3.5 MANUFACTURER'S FIELD SERVICES

A. Provide the services of a Factory Trained, licensed authorized technical representative of the manufacturer of the equipment to supervise the installation and final connections, plus adjusting, programming and all testing of the system required to assure a complete and fully operative facility in accordance with the specifications; and to instruct designated personnel in the operation, adjustment, testing and maintenance of the system. Provide letter certifying results of test.

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B. Include testing at substantial completion, at 6 months after occupancy and again t end of first year warranty. (Total of 3 complete documented tests). Invite the Ow Local Fire Department to witness each test.

C. Include testing of the fire alarm system Horn/Strobe audio/visual devices to assu are operating according to the guidelines set by the NFPA 72 and the Americans Act (ADA).
   1. The limitations are as follows: NFPA – "Audible signals intended for operation in the public mode should have a sound level of not less than 75 dBA at 10 feet or more than 130 dBA at the minimum hearing distance from the audible appliance." ADA – "Audible emergency alarms shall produce a sound that exceeds the prevailing equivalent sound level in the room or space by at least 15 dBA or exceeds any maximum sound level with a duration of 60 seconds by 5 dBA, whichever is louder. Sound levels for alarm signals shall not exceed 120 dBA."
   2. Test the audio/visual units and make adjustments where required, including setting volume of horns and replacing strobes with proper intensity level. If horns are not adjustable then replace for proper dB level. Submit findings in writing, with areas marked that do not meet criteria after adjustments have been made.

3.6 SYSTEM FIELD TEST

A. Test in accordance with NFPA 72 and local fire department requirements. See PART 1 of this specification, article "SUBMITTALS" for additional requirements.

B. Test shall include but not be limited to:
   1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
   2. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
   3. Verify activation of all flow switches.
   4. Open initiating device circuits and verify that the trouble signal actuates.
   5. Open signaling line circuits and verify that the trouble signal actuates.
   6. Open and short notification appliance circuits and verify that trouble signal actuates.
   7. Open and short (wire only) network communications and verify that trouble signals are received at network annunciators or reporting terminals.
   8. Ground initiating device circuits and verify response of trouble signals.
   9. Ground signaling line circuits and verify response of trouble signals.
   10. Ground notification appliance circuits and verify response of trouble signals.
   11. Check alert tone and prerecorded voice message to all alarm notification devices.
   12. Check installation, supervision, and operation of all intelligent smoke detectors using walk test.
   13. Each of the alarm conditions that the system is required to detect shall be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control panel points.
   14. When the Vendor determines that the system must be equipped with optional features to satisfy this specification, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

C. Arrange for final system test and approval by the Local Fire Department (Authority Having Jurisdiction).

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3.7 FINAL INSPECTION

A. A factory trained representative shall demonstrate that the system functions as sp

B. Demonstrate in the presence of the Owner, Local Fire Chief, and the contra Architect's representative.

3.8 INSTRUCTIONS

A. In addition to the site training on programming features previously specified, provide minimum of two four hour periods to instruct the owner in the proper operation and maintenance requirements of the system. Provide one four hour period at substantial completion (after all testing and the system is fully operational and accepted by the fire department) and the other four hour period six months after substantial completion. Video tape both training sessions for owner's record.

B. Provide a typewritten, bound, laminated "Sequence of Operation" to the Owner.

3.9 TRAINING

A. Provide minimum of two on site training sessions on programming features. Each training session shall be a minimum of one hour each.

END OF SECTION 260721

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SECTION 312000 - 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.

1.2 SUMMARY

A. Section Includes:
1. Preparing subgrades and finish grades. Cutting, filling, and providing additional materials required.
2. Excavating, filling, and backfilling to grade.
3. Excavating and backfilling for buried structures, tanks, pipes, wires, and conduits.
4. Subbase and base course for roadways and walks.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and finish pavement.

C. Bedding Course: Aggregate layer 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. Crushed Stone (Drainage Fill): Crushed stone backfill to facilitate stormwater flow; that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
2. Open (bulk) Excavation: Excavation more than 6 feet (3 m) in width.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 2 cu. yd. (1.5 cu. m) for bulk excavation, footing, trench, and pit

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excavation, that cannot be removed by rock excavating equipment, without sy ram hammering, or blasting, when permitted. Fragmented "weathered" roc removed by excavation equipment with "ripper" teeth will be considered earth.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, electrical appurtenances, or other man-made stationary features constructed ab ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course beneath pavement.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each soil material proposed for fill and backfill as follows:
1. Classification according to ASTM D 2487; with particle gradation test results.
2. Laboratory compaction curve according to ASTM D 1557.

C. Pre-excavation Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.5 QUALITY ASSURANCE

A. Blasting: Not Anticipated. If ledge is encountered and blasting is approved by Owner, comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:
1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
2. Seismographic monitoring during blasting operations.

B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
2. Seismographic monitoring during blasting operations.

C. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

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1.6 PROJECT CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project site clearing.
   1. Pre-mark the boundaries of your planned excavation with white paint, fla utility crews know where to mark their lines.
   2. Call Dig Safe, at either 811 or 1-888-DIGSAFE, at least 72 business hours - but no more than 30 calendar days - before starting work. Don't assume someone else will make the call.
   3. If blasting, notify Dig Safe at least 24 business hours in advance.
   4. Wait 72 business hours for lines to be located and marked with color-coded paint, flags or stakes. Note the color of the marks and the type of utilities they indicate. Transfer these marks to the As-Built drawings.
   5. Contact the landowner and other non-member utilities (water, sewer, gas, etc.), for them to mark the locations of their underground facilities. Transfer these marks to the As-Built drawings.
   6. Re-notify Dig Safe and the non-member utilities if the digging, drilling or blasting does not occur within 30 calendar days, or if the marks are lost due to weather conditions, site work activity or any other reason.
   7. Hand dig within 18 inches in any direction of any underground line until the line is exposed. Mechanical methods may be used for initial site penetration, such as removal of pavement or rock.
   8. Dig Safe requirements are in addition to town, city and/or state DOT street opening permit requirements.
   9. For complete Dig Safe requirements, visit their website.
   10. If you damage, dislocate or disturb any underground utility line, immediately notify the affected utility. If damage creates safety concerns, call the fire department and take immediate steps to safeguard health and property.
   11. Any time an underground line is damaged or disturbed, or if lines are improperly marked, you must call Dig Safe.

B. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect or Owner, and then only after arranging to provide temporary utility services according to requirements of the City and utility companies.

D. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures are in place.

1.7 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction. The Contractor shall conduct his operations in conformity with all Federal and State permit requirements concerning water, air,

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or noise pollution, or the disposal of contaminated or hazardous materials. measures shown on the Plans are minimum only and are not intended to be c the current requirements of the regulatory agencies.

B. Inspect, maintain, and repair erosion- and sedimentation-control measures du until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

1.8 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed, or abandoned in place.
   1. Arrange with utility companies to shut off indicated utilities.
   2. Owner will arrange to shut off indicated utilities within his control, when requested by Contractor.

B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Architect and Owner not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without the utility company's and Owner's written permission.

C. Excavate for and remove underground utilities indicated to be removed.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487 or a combination of these groups, free of rock or gravel larger than 6 inches (15 0 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or a combination of these groups. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with 100 percent passing a 6-inch (150-mm) sieve, 25-70 percent passing a 1/4-inch (6-mm) sieve, 0-30 percent passing a No. 40 (0.425-mm) sieve, and not more than 7 percent passing a No. 200 (0.075-mm) sieve. Maximum size stone passes 6-inch sieve. MDOT spec. 703.06 Type D.

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E. Base Course: Naturally or artificially graded mixture of natural or crushed stone, and natural or crushed sand; ASTM D 2940; with 100 percent passing a sieve, 35-75 percent passing a 1/2–inch (13-mm)sieve, 25-60 percent passin mm)sieve, 0-25 percent passing a No. 40 (0.425-mm) sieve, and not more passing a No. 200 (0.075-mm) sieve. MDOT spec. 703.06 Type B.

F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with 100 percent passing a 2-inch (50-mm) sieve, 25-100 percent passing 1/4-inch (6-mm) sieve, 0-30 percent passing the No. 40 (0.425-mm) sieve, and not more than 7 percent passing a No. 200 (0.075-mm) sieve.

G. Crushed Stone (Drainage Fill): Narrowly graded mixture of washed crushed stone; ASTM C 33; grading Size 56; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.

H. Granular Borrow: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with maximum stone size of 6”(150-mm); the portion passing a 3-inch (75-mm) sieve shall meet the following: 100 percent passing the 3–inch (75-mm) sieve, 60-100 percent passing the 1/4–inch (6-mm) sieve, 0-50 percent passing the No. 40 sieve, and not more than 7 percent passing a No. 200 (0.075-mm) sieve. MDOT spec. 703.06 Type F.

I. Sand: ASTM C 33; fine aggregate.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf (700 N); ASTM D 4632.
3. Sewn Seam Strength: 142 lbf (630 N); ASTM D 4632.
4. Tear Strength: 56 lbf (250 N); ASTM D 4533.
5. Puncture Strength: 56 lbf (250 N); ASTM D 4833.
6. Apparent Opening Size: No. 70 (0.212-mm) sieve, maximum; ASTM D 4751.
7. Permittivity: 0.2 per second, minimum; ASTM D 4491.
8. UV Stability: 70 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf (1100 N); ASTM D 4632.
3. Sewn Seam Strength: 222 lbf (990 N); ASTM D 4632.
4. Tear Strength: 90 lbf (400 N); ASTM D 4533.
5. Puncture Strength: 90 lbf (400 N); ASTM D 4833.
6. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

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2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting, low-density, flowable c
produced from the following:
1. Portland Cement: ASTM C 150, Type I.
2. Fly Ash: ASTM C 618, Class C or F.
3. Normal-Weight Aggregate: ASTM C 33, 3/8-inch (10-mm) nominal maximum aggregate size.
4. Water: ASTM C 94/C 94M.
5. Air-Entraining Admixture: ASTM C 260.

B. Produce conventional-weight, controlled low-strength material with 140-psi (965-kPa) compressive strength when tested according to ASTM C 495.

2.4 INSULATION BOARD

A. Extruded polystyrene with a "K" factor of 0.18, with 2.2 lb./cu. ft. density, and 30 psi compressive strength, manufactured by Dow Chemical, or approved equal. ASTM C 578, Type VI.

2.5 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:
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.

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 earth moving operations.

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B. Protect and maintain erosion and sedimentation controls during earth moving o

C. Protect subgrades and foundation soils from freezing temperatures and temporary protection before placing subsequent materials.

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. Water from construction dewatering operations shall be cleaned of sediment before reaching wetlands, water bodies, streams, or site boundaries. Conform to the requirements of the Department of Environmental Protection.

3.3 EXPLOSIVES

A. Explosives: Not Anticipated. If explosives are needed and are approved by Owner, obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.
   1. Perform blasting without damaging adjacent structures, property, or site improvements.
   2. Perform blasting without weakening the bearing capacity of rock subgrade and with the least-practicable disturbance to rock to remain.

B. Rock excavation is not anticipated, however if encountered, ledge rock excavation cost shall be approved prior to excavation. Prior to blasting and rock excavation, provide survey grades of the top of the ledge surface, and calculations of the expected rock quantities to be excavated. Submit this data and obtain Architect's approval prior to proceeding with rock excavation. The Architect will determine the extent of rock excavation and classification.

3.4 EXCAVATION, GENERAL

A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock.
   1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
      a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
   2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction.

B. If hazardous waste or special waste as defined by the U. S. Environmental Protection Agency or State Department of Environmental Protection is encountered during excavation, the Contractor shall avoid disturbance of that material, and shall notify the Owner immediately. The State Bureau of Oil and Hazardous Waste Control must be notified and consulted prior to disturbance of the waste or contaminated soil. Removal and disposal of contaminated materials is not

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included in the Contract Bid, since it must be handled as directed by the regulat
a case-by-case basis.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate for underground tanks, basins, and mechanical or electrical util
indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 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. 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.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line, unless pipe inverts are shown otherwise.

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: As indicated.

C. Trench Bottoms: For ductile iron pipe, 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 6 inches (150 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
   2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
   3. Excavate trenches 8 inches (200 mm) deeper than bottom of pipe elevation in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: For pipe materials other than ductile iron, excavate trenches 4 inches (100 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
   1. Excavate trenches 8 inches (200 mm) deeper than bottom of pipe elevation in rock or other unyielding bearing material to allow for bedding course.

3.8 SUBGRADE INSPECTION

A. Notify Architect and Geotechnical Engineer when excavations have reached required subgrade.

B. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

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C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accum construction activities, as directed by Geotechnical Engineer, without additiona

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending 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 Architect.
   1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

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 trees.

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.
   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. Place backfill on subgrades free of mud, frost, snow, or ice.

B. 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.

C. Place and compact initial backfill of bedding course material, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.
   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

D. Place and compact final backfill of satisfactory soil to final subgrade elevation.

E. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

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3.13 INSULATION BOARD

A. Place a leveling course of sand, 2 inches (50 mm) thick, over subgrade. Finish to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedg
   1. Place leveling course on subgrades free of mud, frost, snow, or ice.

B. Install insulation board in layers with abutting edges and ends along pipelines or other objects to be insulated.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction 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 (150 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 weight according to ASTM D 1557:
   1. Under structures, building slabs, steps, walkways, 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. Under lawns, turf, 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.
   3. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.
   4. Compact crush stone to 100 percent of its dry rodded weight.

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, turf, or unpaved Areas: Plus or minus 1 inch (25 mm).
   2. Pavements and walks: Plus or minus 1/2 inch (13 mm).

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3.17 SUBBASE AND BASE COURSES

A. Place subbase course and base course on subgrades free of mud, frost, snow, or

B. On prepared subgrade or granular fill layer, place subbase course and ba pavements and walks as follows:
   1. Where fill is required, place satisfactory soil or granular borrow fill on prepared subgrade.
   2. Place base course material over subbase course under hot-mix asphalt pavement, concrete pavement, and unit pavers.
   3. Shape subbase course and base course to required crown elevations and cross-slope grades.
   4. Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
   5. Place subbase course 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 course 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.

3.18 FIELD QUALITY CONTROL

A. Testing Agency: If deemed necessary, the Owner will engage a qualified Geotechnical Engineering testing agency to perform field quality control testing and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
   1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 1000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than three tests.
   2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 100 feet (30 m) or less of trench length, but no fewer than two tests.

D. 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 materials to depth required; recompact and retest until specified compaction is obtained.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property. Comply with the requirements of Division 01 “Construction Waste Management”.

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SECTION 321216 - 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. Saw-cutting or cold milling of existing asphalt pavement.
   2. Hot-mix asphalt patching.
   3. Hot-mix asphalt paving.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include technical data and tested physical and performance properties.
   2. Job-Mix Designs: For each job mix proposed for the Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Material Certificates: For each paving material.

C. Material Test Reports: For each paving material, by a qualified testing agency.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the latest revision of "Standard Specifications for Highways and Bridges" of the State of Maine Department of Transportation (MDOT), for asphalt paving work.
   1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

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1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is w damp, if rain is imminent or expected before time required for adequate cure, o conditions are not met:
   1. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
   2. Slurry Coat: Comply with weather limitations in ASTM D 3910.
   3. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
   4. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

   1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320, conform to MDOT specification Sec. 702.

B. Tack Coat: AASHTO M 140 emulsified asphalt, or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application. Emulsified asphalt conforming to MDOT 702.04.

C. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled asphalt shingles from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

B. Joint Sealant: ASTM D 6690 hot-applied, single-component, polymer-modified bituminous sealant.

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C. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate fr complying with FS TT-P-1952, Type II, with drying time of less than 45 minut
   1. Color: White.
   2. Available Manufacturers: Subject to compliance with requirement offering products that may be incorporated into the Work include, but a the following:
      a. Sherwin-Williams Waterborne Traffic Paint, or equal.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:
   1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
   2. Roads and Walks:
      a. Surface Course: Conforming to HMA 12.5mm. MDOT, Section 703.09.
      b. Binder Course: Conforming to HMA 19mm. MDOT, Section 703.09.

Sieve Size	Percent by Weight Passing – Combined Aggregate		
	Type 19 mm (B)	Type 12.5 mm (C)	Type 9.5 mm (D)
25 mm (1 in)	100		
19 mm (3/4 in)	90-100	100	
12.5 mm (1/2 in)	-90	90-100	100
9.5 mm (3/8 in)	-	-90	90-100
4.75 mm (No. 4)	-	-	-90
2.36 mm (No. 8)	23-49	28-58	32-67
75 µm (No. 200)	2-8	2-10	2-10

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. 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, and underground conduits and utilities have been completed.

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3.2 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mı of adjacent sound pavement, unless otherwise indicated. Cut excavation Remove excavated material. Recompact existing unbound-aggregate base coı subgrade.

B. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply 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. Placing Patch Material: Fill excavated pavement areas 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 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. Treat exposed existing horizontal and vertical pavement surfaces with sprayed bituminous tack coat prior to placing new adjacent or overlaying bituminous pavement. Pavement which has been in place longer than 30 days shall be considered existing.

3.5 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

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1. Place hot-mix asphalt base course in number of lifts and thicknesses indi
2. Spread mix at a minimum temperature of 250 deg F (121 deg C).
3. Begin applying mix along centerline of crown for crowned sections an one-way slopes unless otherwise indicated.
4. Regulate paver machine speed to obtain smooth, continuous surface tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.
   1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches (25 to 38 mm) from strip to strip to ensure proper compaction of mix along longitudinal joints.
   2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
   1. Clean contact surfaces and apply tack coat to joints.
   2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
   3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
   4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
   5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
   6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.7 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
   1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

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1. Average Density: 95 percent of reference laboratory density according to less than 92.5 percent or greater than 97.5 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix is warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for at least 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. 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). Apply sufficient thickness to completely cover the underlying pavement with solid white (or yellow) lines, such that no pavement color shows through.

3.9 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch (13 mm).
2. Surface Course: Plus 1/4 inch (6 mm), no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 3/8 inch (9 mm).
2. Surface Course: 1/4 inch (6 mm).
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

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3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests This will not relieve the Contractor of his quality control responsibilities

B. Thickness: In-place compacted thickness of hot-mix asphalt courses wil according to ASTM D 3549.

C. Alignment: Pavement edges shall be in conformance to alignment with straight edges or smooth curved edges, without irregularities or ragged edges.

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 uncompacted paving mixtures and compacted pavement according to MDOT specifications.
   1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
   2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
      a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than three cores taken.
      b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

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.

3.11 WASTE HANDLING

A. General: Handle asphalt-paving waste according to approved waste management plan required in Division 01 Section "Construction Waste Management and Disposal."

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SECTION 331000 - WATER DISTRIBUTION PIPING

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 water-distribution piping, connections, and related components outside the building for complete operational domestic water service and fire-service lines.

1.3 Utility companies usually provide water meters and bill charges directly or through Contractor to Owner. Contact utility company serving the site for information. Delete paragraph below if water meters are provided by utility company or Contractor. If utility company furnishes water meters, identify the company here and specify what it will do; then edit text to suit Project.

1.4 DEFINITIONS

A. EPDM: Ethylene propylene diene terpolymer rubber.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PA: Polyamide (nylon) plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

H. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
   1. Wiring Diagrams: Power, signal, and control wiring for alarms.

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C. Coordination Drawings: For piping and specialties including relation to other area, drawn to scale. Show piping and specialty sizes and valves, meter and sp and elevations.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. 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.

C. 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.

D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

G. NSF Compliance:
1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.7 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.

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2. Protect from weather. Store indoors and maintain temperature higher th point temperature. Support off the ground or pavement in watertight outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handlin Rig valves to avoid damage to exposed parts. Do not use handwheels or st 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.

1.8 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 Architect, Owner, and utility company no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without utility company's written permission.

1.9 COORDINATION

A. Coordinate installation within street right-of-way, including connection to water main with utility company.

PART 2 - PRODUCTS

2.1 First five articles below include examples of materials used for water-distribution piping. See "Writing Guide" Article in the Evaluations.

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Push-on-Joint, Ductile-Iron Pipe: Class 52, AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated. Cement lined and seal coated to meet AWWA C104. Joints meet AWWA C111.
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Pipe: Bituminous interior and exterior coatings of 2 mils dry film thickness minimum.

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3. Fittings: Class 350 pressure rating in accordance with AWWA C interior and exterior coatings of 4 mils dry film thickness minimum. Gla bolts and nuts.
4. Gaskets: AWWA C111, rubber.
5. Polyethylene tube-type encasement: Wrap pipe and fittings with 8-mil HDCLPE to prevent contact of pipe and soil backfill, but not necessai tight.

2.3 HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS

A. High-density polyethylene PE 3408 tubing conforming to AWWA C906, SDR-11, rated for water service at 160 psi sustained pressure. For diameters 2 inches or smaller, use compression type fittings with pipe stiffeners. For diameters larger than 2 inches, use heat-fusion welded joints.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and Cor-Ten steel bolts.

2.4 PVC WATER SERVICE PIPE AND FITTINGS

A. PVC piping for services smaller than 4 inches diameter shall conform to ASTM 2241, SDR-21, rated for water service at 200 psi sustained pressure. Push-on rubber gasket joints meeting ASTM F 477.

1. Fittings: Schedule 40 or 80 PVC meeting ASTM D 3139.

2.5 JOINING MATERIALS

A. Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.6 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Clow gate valves, meeting Water District standards.

2. Nonrising-Stem, Resilient-Seated Gate Valves:
   a. Description: Gray- or ductile-iron body and bonnet, meeting AWWA C153; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      1) Standard: AWWA C509.
      2) Minimum Working Pressure Rating: 200 psig (1380 kPa).
      3) End Connections: Mechanical joint, with 'Cor-ten' or equal bolts and nuts.
      4) Interior Coating: Complying with AWWA C550.
      5) Direction of Opening: Right, coordinated with the Water District standard.

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2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:
   1. Description: Sleeve and valve compatible with drilling machine.
      a. Standard: MSS SP-60.
      b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-pie with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve. AWWA C207, Class D, 200 psi. working pressure rating.
      c. Mechanical joint, with 'Cor-ten' or equal bolts and nuts. Bituminous interior and exterior coatings of 4 mils dry film thickness minimum.
      d. Valve: AWWA C509, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.
   1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground Water-Service and Fire-Service-Main Piping within City Right-Of-Way, NPS 4 to NPS 8 (DN 100 to DN 200), shall be Ductile-iron, push-on-joint pipe; ductile-iron, mechanical-joint fittings.

F. Wrap pipe and fittings with polyethylene tube-type encasement to prevent contact of pipe and soil backfill, but not necessarily air-or water-tight.

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3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for underground ir threaded- or flanged-end valves for installation in vaults.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. See Division 22 Section "Common Work Results for Plumbing" for piping-system common requirements.

3.5 PIPING INSTALLATION

A. Water-Main Connection: Coordinate with the utility company for tap of size and in location indicated in water main.

B. Make connections larger than NPS 2 (DN 50) with tapping machine according to the following:
   1. Install tapping sleeve and tapping valve according to MSS SP-60.
   2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
   3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
   4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

C. Make connections NPS 2 (DN 50) and smaller with drilling machine according to the following:
   1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
   2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
   3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
   4. Install corporation valves into service-saddle assemblies.
   5. Install manifold for multiple taps in water main.
   6. Install curb valve in water-service piping with head pointing up and with service box.

D. Comply with NFPA 24 for fire-service-main piping materials and installation.
   1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
   2. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

E. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
   1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.

F. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

G. Bury piping with depth of cover over top at least 5 ft., for frost protection.

H. 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.

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1. Terminate water-service piping at building wall until building-water-pi installed. Terminate piping with caps, plugs, or flanges as required for Make connections to building-water-piping systems when those systems

I. Sleeves are specified in Division 22 Section "Common Work Results for Plumb

J. Mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

K. 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.

3.6 JOINT CONSTRUCTION

A. See Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.

B. Make pipe joints according to the following:
   1. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure. Refer to Division 22 Section "Common Work Results for Plumbing" for joining piping of dissimilar metals.

3.7 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.
   2. Locking mechanical joints.
   3. Set-screw mechanical retainer glands.
   4. Bolted flanged joints.
   5. Heat-fused joints.
   6. Pipe clamps and tie rods.

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. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
   3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
   4. 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.

3.8 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. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

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C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground va vaults with stem pointing up and with vertical cast-iron indicator post.

D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.

E. MSS Valves: Install as component of connected piping system.

F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.9 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.

3.10 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."

B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Division 22 Section "Common Work Results for Plumbing" for identifying devices.

3.11 CLEANING

A. Coordinate flushing and chlorination with the Water District. Clean and disinfect water-distribution piping to meet Water District standards, generally 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.
   3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

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a. Fill system or part of system with water/chlorine solution conta
ppm of chlorine; isolate and allow to stand for 24 hours.
b. Drain system or part of system of previous solution and refill wit
solution containing at least 200 ppm of chlorine; isolate and allo
hours.
c. After standing time, flush system with clean, potable water u
remains in water coming from system.
d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities, and submit to Water District and Architect.

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SECTION 333000 - SANITARY SEWERS

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, with the following components:
   1. Pipe and fittings.
   2. Precast concrete manhole components.
   3. Precast concrete grease trap.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene-monomer rubber.

C. FRP: Fiberglass-reinforced plastic.

D. LLDPE: Linear low-density, polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

H. RTRF: Glass-fiber-reinforced, thermosetting-resin fitting.

I. RTRP: Glass-fiber-reinforced, thermosetting-resin pipe.

J. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water (30 kPa).

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1.5 SUBMITTALS

A. Product Data: For materials including the following:
   1. Pipe materials.
   2. Fittings and joints.
   3. Manholes, frames & covers, pipe sleeves.
   4. Precast concrete tanks.

B. Field quality-control test reports.

1.6 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.

C. Handle manholes according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewerage 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 service according to requirements indicated:
   1. Notify Architect, Owner, and utility company no fewer than two days in advance of proposed interruption of service.
   2. Do not proceed with interruption of service without Owner's or utility company's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Use the following materials for sanitary sewer lines:

2.2 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe (non-pressure) 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.

2.3 MANHOLE COMPONENTS

A. Standard Precast Concrete Manholes:
   1. Top Section: Eccentric-cone type of size that matches grade rings.
   2. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
   3. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.

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4. Adjusting Rings: Interlocking rings with level or sloped edge in thickn matching manhole frame and cover. Include sealant recommended by ri
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm to match diameter of manhole frame and cover.
6. Protective Coating: Plant-applied, SSPC-Paint 16, coal-tar, or epoxy- applied to exterior surfaces.
7. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SEWER."
   a. Material: ASTM A 48/A 48M, Class 35 gray iron, unless otherwise indicated.

2.4 PRECAST REINFORCED CONCRETE GREASE TRAP

A. Constructed of 4000 psi concrete, designed to support an H-20 wheel loading. The 1000-gallon capacity tank shall have two 24 inch diameter cleanout manhole covers with precast concrete manhole sections, frames, and covers raised to finish grade, at the tank ends.

B. For vent piping, use PVC SDR 35 pipe.

2.5 MISCELLANEOUS MATERIALS

A. Paint: SSPC-Paint 16.

B. PE Sheeting: ASTM D 4397, with at least 8-mil (0.2-mm) thickness or other equivalent, impervious material.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, 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 sanitary sewerage 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 using lubricants, cements, and other installation requirements.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

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D. Install gravity-flow, non-pressure, drainage piping according to the following:
   1. Install piping pitched down in direction of flow, at minimum slope of otherwise indicated.
   2. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668
   3. Install piping with 4.5 ft. minimum cover.

E. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

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 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent Piping."

B. Make connections to existing piping and underground manholes.
   1. Use commercially manufactured wye fittings or saddles for piping branch connections. Cut existing pipe; install wye fitting or saddle into existing piping; and encase entire wye fitting, plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
   2. Make connections to underground manholes by cutting opening into existing wall large enough to allow installation of water-tight flexible boot connector; Cor-N-Seal ring, or equal.
   3. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.5 CLOSING ABANDONED SANITARY SEWERAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
   1. Close open ends of piping with concrete mortar, and if opening is large use at least 8-inch (200-mm) thick, brick masonry bulkheads.
   2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Backfill to grade according to Division 31 Section "Earth Moving."

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3.6 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth M
for installation of green warning tapes directly over piping and at outside edge
manholes.
   1. Use warning tape or detectable warning tape over ferrous piping.
   2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.7 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.
   1. Submit separate report 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.

3.8 CLEANING

A. Clean interior of piping and structures of dirt and superfluous material.

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